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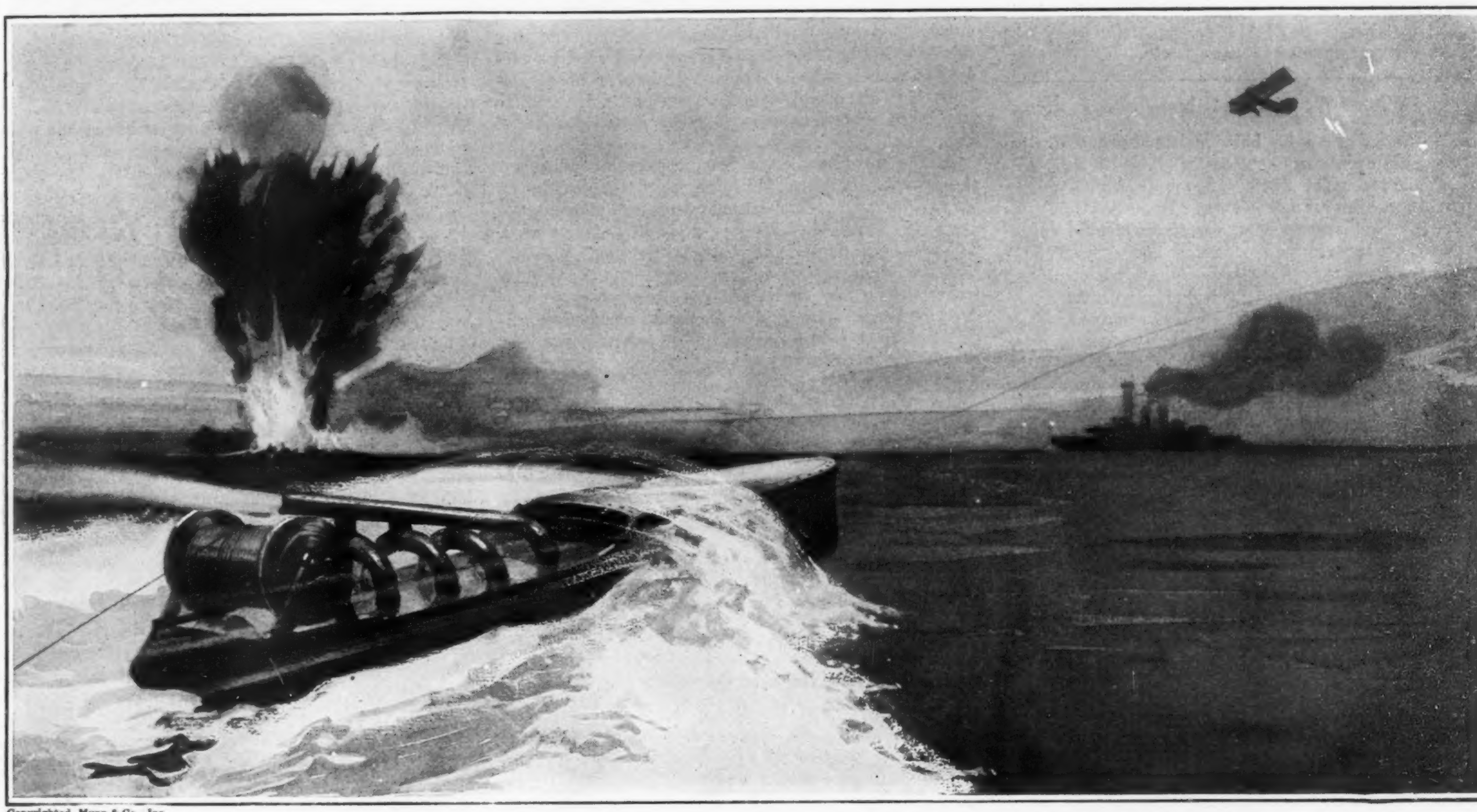

Our artist's conception of the electrically-operated crewless raiders employed by the Germans against the British monitors patrolling the waters off the Belgian coast

German Raiders Which Put Out to Sea Without Crews

ONCE more the Germans have sprung a surprise on the Allied forces, this time in the shape of a crewless raider that is electrically-operated through a cable from a shore station. Already several of these craft have been encountered by British warships cruising off the Belgian coast, but at the moment of writing all such attacks have failed of result.

The crewless raider idea is by no means new. As far back as 1885, the British Admiralty experimented with a similarly controlled vessel known as the "Vernon." In our own country the same idea was put forward some twenty years ago, in the form of the Sims-Edison directive torpedo, which was driven by an electric motor carried within the shell of the torpedo. This crewless craft was steered by exciting certain magnets that controlled the steering gear. Current for operating the motor and magnets was supplied through a flexible cable that was wound upon a reel carried within the shell of the torpedo, with one end connected to the shore. As the torpedo traveled through the water the cable was paid out in its wake, just as in the case of a cable ship. The torpedo proper was maintained at the proper depth by attaching it to a canoe-shaped float. To enable the operator to follow the course of the torpedo, two small poles were carried on the float, and by keeping his eye on these, the operator was supposed to be able to steer the deadly weapon toward its target. By night two colored lights were carried at the top of the masts, and each was hooded in such a manner that while it was visible to the operator, it remained invisible to the enemy.

The "Victoria," an Australian invention, differed from the last-mentioned in being entirely submergible and in using compressed air as its motive power. When first started it hauled a cable after it, unwinding it from a reel on shore. The first part of the journey was covered at a moderate speed. When the operator had guided his craft to within striking distance of the enemy, however, an electrical impulse was sent through the cable in order to release a reel on the torpedo, which then began to pay out cable in its wake. At the same time the impulse also started the air engines at full speed, and the final dash for the ship was made. Still another type of crewless destroyer was the "Brennon," which received considerable attention as the result of its being taken up by the British Admiralty and subjected to exhaustive experiments.

But all directive torpedoes were found to be only moderately successful, and none of them gained much favor with the naval authorities. For one thing, the trailing cable presented numerous difficulties in operation; and the craft, equipped with either an electric motor or a pneumatic engine, was not over-powerful for the work at hand. The main objection, however, was in the matter of visibility: the Sims-Edison torpedo, for instance, could only be followed by the eye to a distance of about two miles, beyond which it was lost to sight. This short range naturally proved a serious obstacle, for in coast defense work it is necessary to be able to strike at an enemy at a far greater distance—at least at a distance as great as the range of his guns.

During 1898 Nikola Tesla, the well-known inventor of New York city, proposed a crewless raider or torpedo operated by wireless waves, and obtained a patent on such a device. Practical wireless telegraphy was then barely a year old, and it is very doubtful indeed if he would have had much success with his radio control if it had been put to a practical test. And even allowing that it would have proved successful, Tesla only solved half the problems, namely, those having to do with the trailing cable; there still remained the paramount question of visibility.

Since Tesla's wireless raider, inventors in practically every country in the world have at some time or another suggested radio-controlled craft for destroying hostile warships, in some instances even building and trying out such vessels with promising results. For our part, John Hays Hammond, Jr., developed a radio-controlled craft which performed remarkably well in experiments at Gloucester Bay, Mass., and it is quite likely that this young inventor achieved the greatest advancement in this field.

Still, naval authorities in the past have preferred to make use of more conventional weapons such as the torpedo, the submarine and the torpedo boat destroyer, leaving the crewless raider aside for future consideration. The last-mentioned weapon, to their mind, was only applicable to coast defense work, and then only under certain ideal and rare conditions.

Coming to the present crewless raiders of the Germans, we learn from statements of the British Admiralty that these are electrically-controlled boats propelled by twin gasoline engines, partially closed in, and are capable of traveling at a high rate of speed. Each raider carries a drum with between 30 and 50 miles of insulated, single-core cable, which is paid out in the wake of the vessel and through which the mechanism is controlled from shore. The forepart carries a considerable charge of high explosive, probably from 300 to 500 pounds, which is arranged to explode on impact.

The method of operating the crewless raider is to start the engines, after which the men leave the boat. A seaplane, protected by a strong fighting patrol, then accompanies the vessel at a distance of from three to five miles and signals to the shore operator of the helm. These signals need only be "starboard," "port," or "steady."

By an obviously clever grouping of the wireless idea, the high-speed gasoline craft, and the electrically-controlled plan, the Germans have made use of the crewless raider scheme in a twentieth century way. They have not overcome the disadvantages of a trailing cable, to be sure; but they have overcome the problem of visibility, for the aerial observer in the seaplane which

(Concluded on page 390)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Where We Stand Without Russia

BEFORE the ever-changing kaleidoscope of Russian events as revealed from day to day, prediction must falter and grow pale. Never has a revolution been brought about under such circumstances, or involved such possibilities of world-wide consequence. On these grounds alone the daily chronicle of Russia's conflict would possess extraordinary interest for all people of all nations. But today, with the world plunged into its greatest international struggle, the battles of Petrograd and Moscow claim our attention even more urgently for another reason. What effect will the Russian Revolution have upon the war is the question which rises instinctively to every lip of whatever nationality.

When we attempt to consider the revolution from this point of view, the first thing which we must realize is that we are at once separating ourselves from the revolutionists by a tremendous gap. The Russian as a class regards the war as an incident of the revolution, rather than the other way about; he is interested in making sure that the war shall not interfere with his revolution rather than that his revolution shall not compromise our war. Alike because of this and because of the physical condition of Russia, we must face the bald fact that this nation is out of the war so far as effective participation is concerned. To be sure, events may so turn out that Russia can and will maintain her lines, making it necessary for Germany in turn to keep up her side of the eastern front; but such maintenance cannot become a burden to Germany, or materially affect her strength on other fronts. It will continue to be, as it has been, a mere formality.

Russia is through. The Allies must fight out the war without her. This there would be no doubt of their ability to do, were it not for the fear, ever present and freely expressed in many quarters, that from the position of an enemy to Germany, Russia will switch about completely to that of an active or passive friend.

Such a situation, looked at in the abstract, would of course be full of peril for us and our allies. Our plan of campaign is to wear Germany down. We expect to beat her by a process of attrition affecting her man-power, her food supply, and her stocks of raw materials. If she is to have a friend or even a benevolent neutral upon her eastern border—a border which, unlike her western one, we can control neither by land nor by sea—if she is to draw freely upon this great neighbor for food and metals and non-combatant labor, this attrition will make its effects felt slowly if at all.

All this is gloomy enough; but when we come down to concrete analysis, we find that after all there is little warrant for pessimism. We have an ancient adage which recites the impossibility of extracting blood from a stone. So long as we speak in general terms, Russia as a source of supplies for Germany appears formidable indeed; but when we descend to details, and particularize as to just what supplies the Boche is to get from Russia and how he is going to get them, we discern a great light.

Is it food that is to be supplied by the new republic? We think not. The summer just past has not been a season of hard labor in Russia; her workers have been working in the same way that her fighters have been fighting—with fine phrases. All men of all factions have been too busy with talking to pay much attention to the sordid details of work. Even now, the Bolsheviki cry for bread; and whence is it to come? Already the food situation in Moscow and Petrograd is reported as desperate. Hungry already, Russia will be hungrier before she is fed; and the thought of Germany drawing sustenance from her is a ludicrous one.

But, persists the calamity howler, think of all the other resources of Russia! Germany can come in and help herself to coal and iron and petroleum and platinum and copper and all the other things of which she has such need. Again we beg to differ. Until coal and oil and metals are able to take legs unto themselves and walk from the Urals and the Caspian to the Rhine, Germany will do nothing of the sort. It takes railroads to move all these things—railroads with tracks and rolling stock and above all, locomotives in good shape. The fact that Russia is crying for fifteen hundred engines to save her from ruin is but faint measure of her transportation conditions. Materials of which there has been most urgent need have lain for two years at Archangel because they could not be moved.

Transportation conditions in France are bad. In Germany they are worse. In Russia they are in a state of indescribable demoralization. If the need were merely for organization and proper use of existing facilities, Germany could step in and bring order out of chaos in a week. But the need is for supplies and equipment, supplies and equipment, and then some more supplies and equipment; and here is the one thing which Germany cannot provide. She is but little better off than Russia. Her troop movements from east to west—the vaunted advantage of her inner lines—are seriously slowed up. She is not able to supply her own cities with coal from her own inexhaustible mines. The suggestion that she is able to restore traffic conditions in Russia to any semblance of order is the height of absurdity.

At the worst, then, the Russian situation does not threaten us. Nothing which can happen in Russia can by any possibility afford Germany a source of supply for any of the things of which she stands in such dire need. The Russian collapse is of course a disaster. It means that the promised German breakdown upon the western front will be postponed, perhaps for a year, perhaps even for longer. But that is the extent of its effect. It does not make Germany's permanent strength one whit greater nor the prospects of eventual Allied triumph one whit less. It does, however, impose upon each of the Allied nations the burden of a greater effort; for whatever contribution Russia was looked to to make to the common campaign must now be made good by the other Allied powers, in addition to their own normal shares. If the power to meet this demand were lacking there would be grounds for apprehension. But there is no such lack. All the combatants on the Allied side appear to be in as good shape as Germany; and with our own resources not yet touched, there can be no doubt of the ability to dispense with Russia. For many months we have been fighting with little or no aid from her. We can continue to do so to the end.

How High is the Aurora?

CONFLICTING statements have been published concerning the altitude of the aurora. In the early part of the nineteenth century Farquharson, in Scotland, reported observing that auroras often illuminated the under surface of clouds, and in one case, from simultaneous observations at two stations, he found an altitude of only 4,000 feet. Trevelyan, from observations in the Shetland and Faroe Islands, concluded that the aurora often descends to 50 feet above sea-level. Perry, the Arctic explorer, reported seeing an auroral ray projected between his ship and the shore. Similarly Lemström, during the Swedish expedition to Spitsbergen in 1868, several times saw auroral lights projected between himself and the nearby mountains, and once found himself in the midst of an aurora. The modern method of measuring the height of the aurora is by means of simultaneous observations, visual or photographic, at two stations connected by telephone. Observations of this sort made at Godthaab, Greenland, some thirty years ago, and discussed by Paulsen have given heights for the lower edge of the aurora ranging from about 2,000 feet up to 42 miles, with an average of about 12 miles. Strange to say the more recent photographic observations of Störmer and those of Vegard and Krogness give very much greater altitudes. In Störmer's measurements of 1913, numbering about 2,500, only 21 gave an altitude under 56 miles, while the usual altitudes were 61 to 68 miles. The measurements reported by Vegard and Krogness showed only one aurora lower than 53 miles, while the greatest altitude observed was 205 miles. Can it be that there is a marked difference in the height of the aurora at different places on the earth? Or does the height differ from time to time with fluctuations in the intensity of electrical discharges from the sun, as suggested by Störmer?

Fatigue Elimination Day

ONE of the principal reasons for the worker's antagonism to the efficiency methods has been a feeling that they meant increased work and output without any serious consideration of the effort required of him. He saw in the measurement of work done and time consumed, a system of spying on his work and a suspicion of laziness or loafing. He felt that he could not produce more work in a given time without expending greater effort and consequently becoming more tired. He felt that the periods of relaxation so necessary in all kinds of manual work were to be eliminated, and that he must keep on driving as if he were a machine made of iron and steel, rather than a complicated living organism of flesh and blood.

While there may have been grounds for this feeling in the earlier days of the efficiency movement—certainly there is no cause for such apprehension at the present day; for one of the studies that is receiving the greatest attention at the present time at the hands of industrial engineers is that of fatigue.

We are learning fast, these days. It has become a patriotic duty to be economical and thrifty, and this applies not only to material things but also to the expenditure of human energy. The work of the efficiency engineer is coming to be appreciated by the masses, because it is realized that he is giving full consideration to the conservation of human energy. Not only is such conservation necessary during the great international struggle of war, it will be of highest importance after the war when we are involved in industrial competition with other nations; all of which lends importance to the movement now on foot to interest the public at large in the question of fatigue elimination.

It has been proposed that the first Monday of December each year be set aside as a "Fatigue Elimination Day" the purpose of this being to focus public attention upon the subject and to produce results similar to those that have arisen from the Safety First movement.

The problem of fatigue elimination is not confined to the factory or to the workshop. It applies equally to the man who does work with his hands and to the man whose work is mental. The subject is very broad and complex. It has been studied by eminent men in this country and abroad, but they suffer from insufficient data. Only by the coöperation of the public at large may any definite results be obtained.

On Monday, December 3d, therefore, the public is urged to give special consideration to fatigue elimination, to study, if possible, some of the work of such men as Colvin, Dealy, Douglas, Gilbreth, Goldmark, Thorndike and others in this country; of Spooner in England, Amar in France, and of Offner and Schlesinger in Germany. On this day, each one is urged to look about him for evidences of unnecessary fatigue. Wherever fatigue is discovered it should be carefully studied to see whether it is necessary or unnecessary.

It will be found that unnecessary fatigue may arise from postures of the worker, from the clothing he wears, from the assignment of the worker to labors for which he is unfitted, from the improper distribution of work and rest periods, from the position of the chair or stool in relation to the desk or work-bench, from the environment by which is meant the nature of ventilation and heating, the lighting and the amount of noise about the worker. Unnecessary strains are put upon the worker by requiring him to stand throughout the day or sit throughout the day. The ideal condition is that in which the worker can spend part of his time standing and part of his time seated. In some places it has been found that a material saving in nervous as well as muscular weariness may be effected by raising the desk and providing a high stool so that the worker, be his work mental or manual, may vary the monotony of his labors by standing at least part of the time. Much attention is being paid in these days to such devices as chairs with foot rests and arm rests. Those who have made a study of fatigue believe that there is scarcely an occupation in which the worker cannot be seated at least one-third of the time; and certainly it is not to the advantage of the worker to remain seated all the time.

Other factors that are liable to be overlooked have to do with the proper fit and weight of clothing, the color of the surroundings and even the color of the machine that is being operated. It has long been recognized that lighting plays a very important part in the question of fatigue; one can suffer from too much light as well as from too little light.

Once the public begins to understand the problem of fatigue, no end of suggestions for its elimination will come forth, and the object of "Fatigue Elimination Day" is to have millions of people looking for the cause of fatigue and for means of eliminating it instead of letting the work devolve upon a few investigators, who, after they have arrived at definite results must then contend with the problem of educating the public to the adoption of their proposals.

New Food-Stuffs in Germany

AN imposing list of new food-stuffs has been published in Germany, and a detailed abstract in English may be found in the *International Review of the Science and Practice of Agriculture* for June, 1917. The materials described include rhubarb leaves, seaweed, straw meal, splet chaff meal, concentrated straw fodder, crushed and ground maize ears, heather stalks, kohl-rabbi by-products, ground sugar-beet seeds, parsely seed, wild radish husks, bran, a mixture of brewers' grain and yeast, wine yeast, ground grape pips, beechnut cake, walnut cake, fish meal, and various mixed foods. Chemical analyses and descriptions of use are given.

Aeronautical

Escadrille Cubaine for France.—According to *Flight*, Col. Manuel Coronado, member of the Cuban Senate, recently announced in Havana the organization of an aviation unit which will be offered to France with complete equipment. Since the declaration of war against Germany on April 8th, Cuba has been coöperating with the Allies in several ways, but it is probable that the Escadrille Cubaine, as the flying unit will be called, will be the first body of fighting men from Cuba to serve on French soil.

Seaplane, Submarine and Depth Bomb.—The British Admiralty in a recent statement tells how a seaplane destroyed a German U-boat in the following words: "A seaplane attacked an enemy submarine which she had observed apparently maneuvering into position to fire a torpedo at a passing merchant ship. Before the seaplane arrived over the submarine the latter submerged, but three bombs were dropped on the position where he had disappeared from sight. In five minutes' time a large upheaval was noticed where the bombs had been dropped; this could best be compared to a huge bubble, rising some distance above the level of the sea, and distinctly visible for a minute or more. There was no further sign of the submarine."

The Fate of Captain Guynemer—the French "Ace."—There now, unfortunately, seems little doubt that Captain Guynemer, the famous French airman, is dead. The Germans have announced in the *Gazette des Ardennes* that he was killed about 800 yards east of the cemetery of Poelcapelle. It is said that a German sergeant found there a one-seater, with a wing broken and the pilot dead from a bullet wound in the head, and on him an identity disk with the name "Georges Guynemer." Captain Guynemer had brought down no less than 53 enemy machines and had been decorated by the French government with the Legion d'Honneur, the Medaille Militaire and the Croix de Guerre. An Elberfeld Telegram to the *Cologne Gazette* states that the German officer who shot down Captain Guynemer, was Flight Lieutenant Wissemann, who himself has since been killed. In his last letter to his parents, in which he described how he brought down the French "Ace", Lieutenant Wissemann wrote: "Do not be anxious, as I can never have a more dangerous enemy."

The Wholesale Destruction of Zeppelins.—There appears to be some doubt as to the exact number of Zeppelins recently destroyed by the French forces, but for a certainty the number is at least five. It appears that the Zeppelins were hampered while flying over England, by the fire of anti-aircraft guns and searchlights, and were compelled to release all their bombs prematurely. Furthermore, they were blown about by strong winds and lost their bearings, and as a result found themselves over French territory too late to avoid disaster. One Zeppelin was captured intact by the French forces, after it was compelled to land by a battleplane. According to news received from Switzerland, it is understood that the city of Friedrichshafen is in mourning over the loss of at least four Zeppelins. The majority of the crews of the destroyed and captured Zeppelins lived in Friedrichshafen. In all probabilities, the Swiss news continues, the bagging of four or more Zeppelins in one day by the French will mean an end to this type of aircraft as an offensive weapon.

Wherein German Constructors Show Great Sagacity.—Time and again it has been admitted in this column that the Teuton is a formidable aerial enemy. And somehow or another he has always been able to keep up with the combined production of Great Britain, France, Italy and Russia, not forgetting such aid as the Allies have received from the American constructors prior to our entering the world war. Just why this Teuton efficiency should remain manifest in the face of what appears to be an overwhelming handicap, is now beginning to be understood. The cardinal fact is that the Teuton, from the beginning, has considered the aeroplane in the light of a big motor fitted with a pair of wings. When the Allies built machines with 80-horse-power rotary engines at the beginning of the war, they found themselves competing with German planes fitted with 120-horse-power Mercedes engines. Needless to say, the Allied machines were hopelessly outclassed; and on the side of the Germans the lack of numbers was made up by the superiority of the unit. Then the Allies went to the 100- and 120-horse-power plane, only to find that the Teuton had already gone to 160, 200 and 220-horse-power. Always have the Allied planes been under-powered; and in order to increase climbing and speed characteristics, the British and French constructors have had to shave off every ounce of cloth and wood possible, to a point where the factor of safety is little more than a name. On the other hand, the Germans, working with a solidly-built machine, meet climbing and speed requirements merely by piling on more horse-power. We Americans have done well in developing the Liberty motor first, before our aeroplanes; for after all the Teuton is quite right: an aeroplane is nothing more than a powerful, reliable motor—with a pair of wings.

Science

The International Journal of American Linguistics.—A quarterly journal under this title has been started under the editorship of Messrs. Franz Boas and Pliny Earle Goddard. It is devoted to the study of American aboriginal languages.

Remarkable Rainfall in England.—During a heavy rainstorm which was more or less general over southern England on the night of June 28th, 1917, a measurement of 9.84 inches was recorded at Bruton, Somerset. This is the heaviest rainfall in 24 hours ever recorded in the British Isles. On the 16th of the same month, during an afternoon thunderstorm, a fall of 4.65 was registered at Campden Hill, Kensington, London; the heaviest fall in 24 hours ever recorded in the metropolis.

Use of Lead as a Fertilizer.—Experiments carried out during the years 1914 and 1915 in Germany showed that aqueous solutions of lead nitrate exercised a stimulating effect on a majority of agricultural plants, provided too much of this substance was not used. The lead nitrate was made into a fine powder and mixed with potash salt or sodium nitrate, used as a fertilizer. Good results were secured with rye, wheat, oats, barley, maize, peas and beets, but not with potatoes.

An Anti-Frost Spray for Fruit.—A consular report from Bordeaux describes a new method of protecting fruit trees against late spring frosts. This consists of spraying them with a chemical mixture called "agélarine," said by its maker to be compounded from the juices of certain plants. It is a liquid, and may be handled in the ordinary hand-spray pump, but after it has been applied and exposed to the air it acquires a waxy consistency and has the appearance of a sugared or resinous coating, which is not washed off by rain and lasts for from two to five weeks.

Prize for Vulcanological Researches.—The Vulcanological Institute founded by Immanual Friedländer, and now located at Schaffhausen, Switzerland, offers a prize of 4,000 francs for the best study submitted before January 1st, 1919, on the formation of regular systems of fractures in a solid crust, especially as related to the thickness of the crust, the materials composing it, and the nature of the shock or force producing the fissures. This is a subject of interest in connection with the distribution of volcanic vents and the thickness of the earth's crust. An additional sum of 2,000 francs is held by the institute at the disposal of approved investigators of this problem to cover the expenses of their experiments, and persons thus aided may also compete for the prize. Further details regarding this contest are set forth in *Archives des Sciences physiques et naturelles*, July 15th, 1917.

A Huge Extinct Bird.—The American Museum of Natural History, in New York, has recently placed on exhibition the bones of a giant extinct bird, found in 1916 by Mr. William Stein in the Bighorn Bad Lands of Wyoming. The Bighorn basin has been a well-known fossil region since 1881, when its riches were first discovered by Dr. J. L. Wortman, who was then collecting for Professor Cope. Dr. Wortman has conducted other fossil hunting expeditions in this region and it was explored by an expedition from Amherst in 1904. Beginning in 1910 the region was thoroughly and systematically explored for the American Museum by Mr. Walter Granger and thousands of fossils were obtained, but only half a dozen belonged to birds. Of these two were fragments of a bird of gigantic size, named by Dr. R. W. Shufeldt *Diatryma gigantea*. The recent discovery in this region of a nearly complete skeleton of this gigantic bird (now known as *Diatryma Steini*) was a piece of unlooked-for good fortune. The bird was, in life, much bigger than an ostrich though not so tall, and more impressive because of its huge head, powerful beak and thick neck.

Experiments in Starving Larvae.—Some astonishing experiments in keeping insect larvae without food are described in a recent paper by J. E. Wodsedalek, of the University of Idaho. The experiments thus far have been made on larvae of the small beetle *Trogoderma tarsale*, well known as a museum pest, but other related species will eventually be used also. Some years ago the writer put several live specimens away in a drawer, without food, and forgot them for five months. At the end of that time he was surprised to find that they were all alive, though they had decreased in size. He then began starvation experiments on a large scale. Specimens were kept without food in individual sterilized vials, and some of them lived for more than five years! Even newly hatched specimens, which had never tasted food at all, lived as long as four months. One remarkable phenomenon was the gradual decrease in size of the specimens. Some of the largest actually shrunk to about one-six-hundredth of their maximum larval mass! Equally astonishing is the fact that when the starved specimens reached almost the smallest possible size and were then given plenty of food they began to grow, and finally regained their original size. In some cases this process was repeated three times.

Automobile

Patriotism and Profits.—It is reported that a few manufacturers of automobiles and needed accessories, taking advantage of the necessities of our armies, are holding the Government up for all the traffic will stand. A little publicity in their cases would probably induce them to see things in a different light. Also there is the possible remedy of commandeering anti-American establishments. Profiteers in all lines of business run the risk of ultimately getting their just dues from an indignant people.

Cleaning Intake Air.—One of the crying defects in automobile construction is at last receiving attention. Every mechanic knows the importance of protecting wearing surfaces of a machine from dirt and grit, and considerable attention has been given to gears and bearings; but that vital part of the engine, the cylinder, has been lost sight of between the engine designers and the carbureter engineer, and allowed to inhale destructive road grit ad libitum.

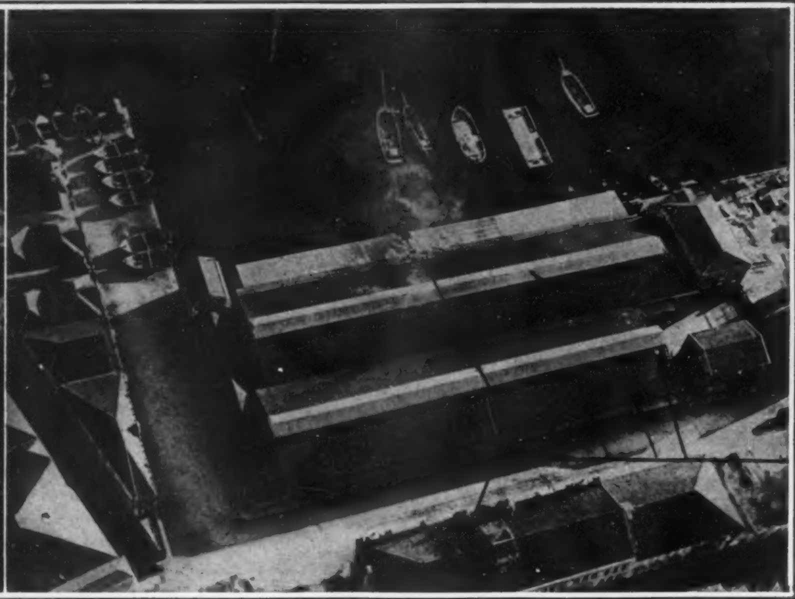
Volatile Contents of Gasoline.—Investigations of gasoline made in England show that in 1907 the average content volatile below 100°, C. varied from 60 to 70%, the final boiling point being from 125° to 130°. In 1912 the volatile portion, as shown in four samples, had decreased to 58, 42, 53, and 34%, and the final boiling point had risen to from 151 to 165°. Last spring similar samples showed from 23% to 45% volatile matter, and the final boiling point above 170°.

What Is An Engineer?—The country is overrun with so-called "automobile engineers," but the visible results of their efforts is infinitesimal, if we compare the number of engineers with visible results. Most of these men are simply ingenious mechanics, who closely watch their neighbors, and then try to do the same thing in a little better way—they are simply traveling in circles—but this is not true engineering. There are plenty of problems awaiting solution by scientifically trained engineers; but in the meantime our mechanics could give us simpler and more durable cars, which is their legitimate province.

Improving Fuel Efficiency.—Owing to the shortage of gasoline in England a number of "dopes," tablets and liquids have been offered to the public which the venders claim will phenomenally increase the mileage to be obtained from a gallon of fuel, and quite a lucrative business has been done. It would hardly seem necessary to say that the claims made are entirely fraudulent, as has been the case with the many fuel substitutes that have been announced in this country: but the public is easily fooled, and it will not be long before similar "tablets" of wonderful qualities will appear here. A chemical analysis made of one of the tablets sold in England showed that it consisted of a very small portion of naphthalene, and two tablets, which was the prescribed dose per gallon of gasoline, increased the calorific value but 0.066 per cent, which is an imperceptible amount.

Water Injection.—There are many devices on the market for adding small quantities of water, or steam, to the fuel mixture as it goes into the cylinder, which it is claimed not only prevents the formation of carbon, but increases the efficiency of the engine; but, although the presence of steam in the cylinder appears to keep such carbon as is formed soft, so that it is quickly blown out, there has been no real scientific investigation of the action in relation to efficiency. It has been customary to use water in large engines using kerosene, the theory being that the excessive heat in the cylinder "cracks" the fuel into elements that explode with undesirable violence, and the addition of the water reduces the temperature to a point where the cracking does not take place. This cooling is desirable in this class of engines, although there is an acknowledged loss in calorific efficiency. Logically, we may expect a similar loss of fuel efficiency in a gasoline engine when water is introduced, and that is not what we are looking for.

A New Gas Container.—The experiments being made in England to use coal gas as a substitute for gasoline for operating motor cars have been referred to heretofore. The first plan was to use the gas at the ordinary street main pressure in a large balloon bag; but it was soon found that a large touring car, or omnibus, could accommodate only about the equivalent of a single gallon of gasoline by this method. Of course compressed gas in steel cylinders was at once suggested, but these do not promise much improvement, and at the present time they cannot be procured in England and are excessively heavy. The latest proposition is a high pressure container, built up of fabric and rubber. A bag of this description 5 feet long and 12 inches inside diameter contains 600 cubic feet of gas at 1,000 pounds pressure, and weighs about 100 pounds. This amount of gas is equal to a little more than two gallons of gasoline; but as the container promises to be quite costly, and in addition the necessary fitting and attachments would amount to about $50, it looks like an expensive luxury beyond the reach of most people.



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General view of the commercial section of Beyrout, showing the conflagration caused by British bombs

Two of the dock sheds at Beyrout, with arrows pointing to the visible damage caused by bombs

Photographic records of the British aerial raid on Beyrout Harbor, in Asia Minor

The Camera at the Front

Why the Military Authorities Have Use for Their Own Cameras But None for the Enemy's

THAT peaceful-looking camera which we use on Sundays for snapping pictures of our friends and of pretty views, becomes a deadly instrument when it is brought into the military world. It may be the means whereby invaluable fortifications can be quickly destroyed; it may give away important ideas or inventions to the enemy; it may betray the location of important batteries and doom them to early destruction; and it may result in heavy loss of life to troops whose position is divulged by the black-and-white markings of a photographic plate or film. At any rate, the camera in the war zone is no longer a peaceful instrument; it is many times deadlier than its equivalent weight of high explosive.

Why the camera should be so deadly in the war zone is due to the ease with which any object can be accurately "described" by means of a photograph. Words alone are of little use alongside a photograph; but the two combined make for accurate and rapid reports on any given subject. For this reason the spies have not overlooked the camera in carrying on their clandestine activities, and it is safe to say that tens of thousands of photographs made by spies have had an important bearing on the fortunes of the world war.

A Caudron cameraplane and its motion-picture apparatus. Note the censor's marking on the side of the fuselage

With the splendid anastigmat lenses available today, together with the high degree of perfection attained in enlarging processes, the spy need not use a large camera. The chances are that in most instances small and readily-concealed pocket cameras are employed, making film or plate negatives measuring an inch square, or possibly 2½ by 3½ inches as the maximum. These negatives, or contact prints made from them, by some route or another make their way to spy headquarters, and there they are enlarged and studied by specialists trained in "reading" photographs. These specialists, we are told, can glean a tremendous amount of information from what would appear to the layman to be a most uninteresting and valueless print. And when such informations are properly collated and distributed to the various military departments where they can do the most good—and the most harm to the opponent—the deadliness of the camera begins to dawn upon us.

So, if the camera is not countenanced about our cantonments and aviation schools and war plants and water fronts, the reason is quite obvious. The military authorities cannot be too drastic as regards the presence of cameras in zones where the enemy could learn much to his advantage from a few chance snapshots.

But it is the airman over the battle lines who makes the most use of the camera. Early in the war the rival camps came to appreciate the importance of aerial photography, and began immediately to develop cameras for this class of work. Today aerial reconnaissance is carried out largely with the aid of photography; large planes, accompanied by fast fighting machines, make their way over the enemy's lines and proceed to photograph a given area.

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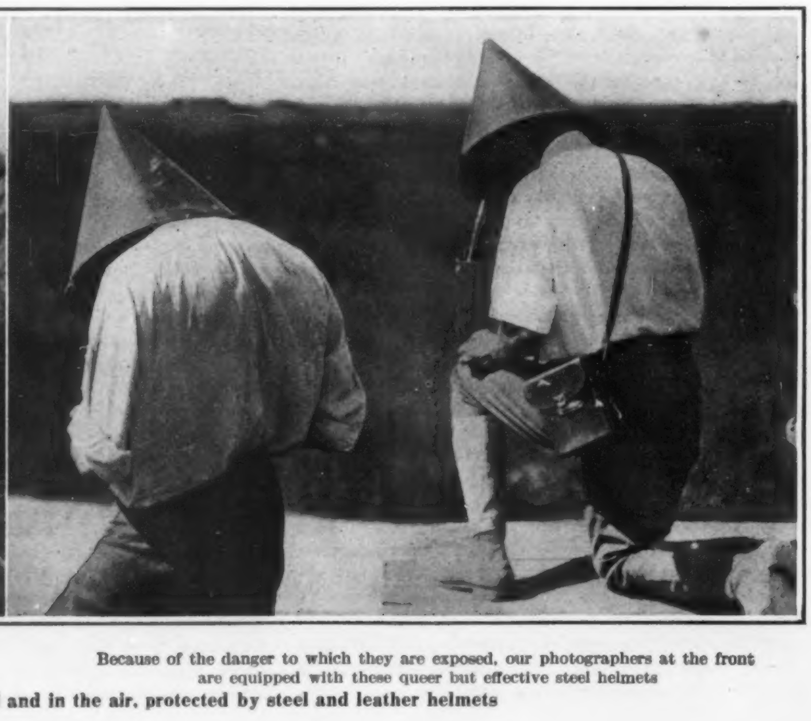

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Instructing an officer-aviator in the manipulation of an aerial camera at the British Royal Naval Air Service School

Because of the danger to which they are exposed, our photographers at the front are equipped with these queer but effective steel helmets

War photographers who snap their cameras on land and in the air, protected by steel and leather helmets

Building the abutments of a bridge

A lesson in primitive bridge engineering

The Scout Movement and the Engineer

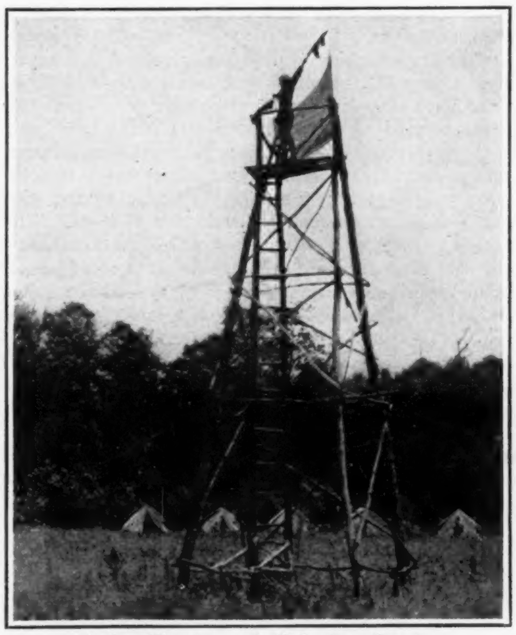
An Opportunity for Service of National Value

By Captain Stuart C. Godfrey, U. S. A.

NO other profession, it can be safely said, has made such a valuable contribution to the Nation-at-War as the Engineers. Of the enthusiastic spirit of those who have sought the military service, I can speak personally from my experience at two training camps for Engineer Reserve Officers. They have served equally well in a hundred other capacities. The purpose of this article is to bring to the attention of engineers an opportunity for National service, perhaps not generally recognized as such. The Boy Scout organization has proved itself, since the war began, a valuable asset to the Government, and has been officially recognized as such. To many an engineer, barred for any reason from service at the front, the opportunity of being a scoutmaster should make a forceful appeal. I can perhaps best emphasize this statement by first describing, somewhat personally, my own experiences as a scoutmaster.

While stationed at West Point, some three years ago I consented to take the leadership of a group of Boy Scouts which had just been organized. Now the prospect of assuming such a responsibility might well stagger any man, were it not that the scout organization and program have been so well planned, and are so fully described in the Scout Handbook. From the start, the boy is fascinated by the activities presented to him. He jumps at the first simple tests in knot-tying, and is led gradually on till he faces the more difficult task of scoutcraft with undaunted enthusiasm.

And so with the aid of the Handbook and Scoutmaster's Manual, it was a fascinating and no very difficult task to make a beginning, to organize the troop into two patrols, each with its elected leader and assistant, to take the first out-of-door hikes and to devise ways and means of earning uniforms and equipment. For the indoor meetings, (the winter nights were approaching) the use of a roomy gynmasium was secured. These meetings opened with an inspection of the troop, at which neatness was insisted upon, and dirtiness or sloppiness of dress was penalized by demerits. Next, it was found, the boys craved some kind of drill, with marching or calisthenics; this should be short and snappy. Then came instruction in one or more of the scouting activities. For these the services of an expert were sometimes utilized. Thus first aid was well taught by one of the Post surgeons; and for one physical drill we had inspiration (and perspiration) from Major Koehler, well known to every Plattsburg graduate. No period should be all work and no play—each program found a place for one or more of the games that scouts love, and for the cheers that afford an opportunity to let off steam. At the end of the meeting came the initiations, promotions and other little ceremonials, which we made as impressive as possible, the scout oath being always repeated by the troop at salute before dismissal. Before the end of the winter the scouts were able to give a creditable indoor exhibition, to which their parents and friends were invited.



A signalling tower built by Boy Scouts

Spring brought a more unrestricted scope for outdoor activities. The services of the Post Forester were now requisitioned for the instruction in tree lore. Signalling could be carried on between distant hilltops. Some of the scouts started off on their "14-mile hike" as if they were going on pioneer voyages of discovery, while others were keen to take their tests in fire-lighting, tracking and the mile-in-twelve-minutes. Longer hikes were taken, which involves the preparation and devouring of a meal en route. The first fearful results of this individual cooking were replaced later by palatable products that might have ornamented any table. A mounted trip of some distance was made one Sunday—every member of the troop having either owned or borrowed for the occasion a bicycle or a horse. Then came great preparations for the first "overnight hike"—the borrowed "pup-tents," the wagon loaded with eats and supplies—preparations that were justified by the success of the expedition, the joy of camping out, the evening around the camp-fire, the night of novelty (if not of sound sleep)!

Of course after that we *had* to have a camp. A good camp-site was found on the shores of "Long Pond," some larger wall-tents were secured, a promising darky cook engaged, and the troop, now 32 strong set out for "Camp Paradise." It was a week chock full of stimulating work and care-free play, with two daily swims, the program ending with a combined field and water meet between the patrols. The boys were fed that season (1915) at a cost of 25 cents a day, which they paid themselves.

The end of the first year, in the fall, found the troop a prosperous "going concern." Half a dozen boys had earned their right to the coveted "first class scout" badge, a measure of no slight achievement for any youth. That basic principle of scouting, the "good turn," had been quietly emphasized, and besides their individual acts of helpfulness, at home and elsewhere, the scouts had rendered several "community good turns." For instance, they had built a rustic bridge on the path to the recently dedicated playground. Their services as ushers and aids at public meetings and festival occasions were much in demand. Best of all, the spirit among the boys on the Post had been completely revolutionized. An army post is not a very wholesome place for a soldier's son to grow up in; there had been some stealing among the boys the year before, and a good deal of idle loafing. All this was now gone. I had tried one boy before a court for dishonesty, and this had had its salutary effect. There has been nothing else of the sort these three years.

The succeeding years have been to a large extent a repetition of the first, but with new developments as well, for the boy needs *something different* to keep his interest fully alive. That fall, selected scouts proudly served as assistant ushers at the Army-Navy football game in

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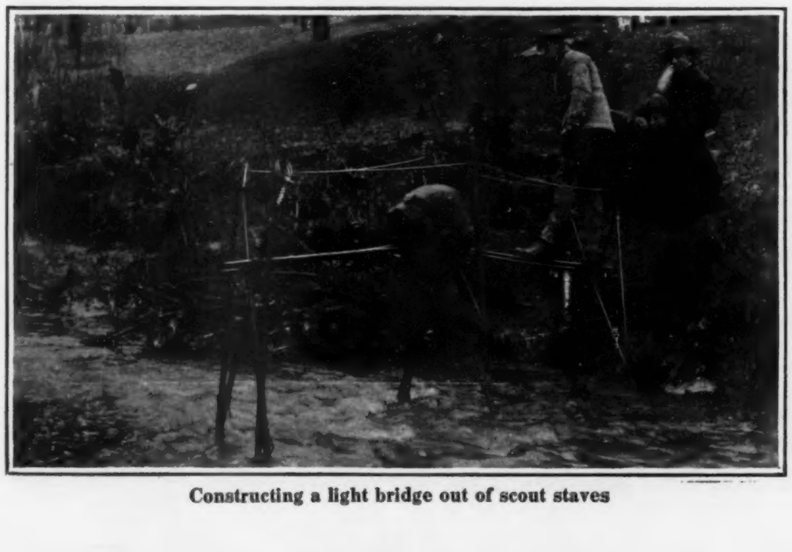
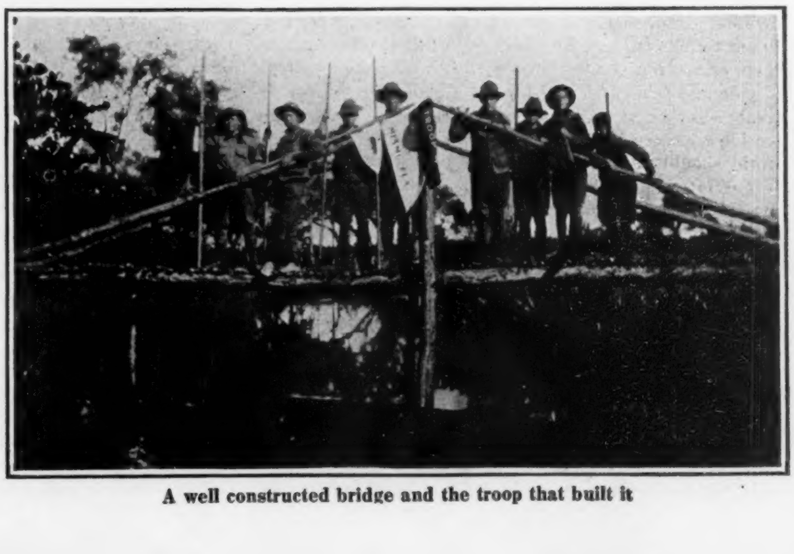


Constructing a light bridge out of scout staves



A well constructed bridge and the troop that built it

After the War—What?

II. The United States as a Factor in the Economics of Restoration

By Ludwig W. Schmidt

IT will be a world depleted of its wealth of raw materials, food and human energy which those who are left when the struggle ends will have to face. New and increased exertions will be demanded. Great losses will have to be made good, and there is no country in the world which in one way or another will not be affected. Each nation will approach this period with different ends in mind; the economic problems of each will be different from those of the others. Indications are that it will be the desire of each country to preserve its resources of materials and foods as much as possible for the benefit of its own citizens, and to allow only so much to go abroad as may be necessary to secure in return a supply of whatever cannot be produced at home.

What will be the position of the United States in this game? It is frequently proclaimed by economists that the household of the United States is self-contained. While this is more nearly true for us than for any other people on the face of the earth, it does not conform strictly with the facts. In the manufacture of rubber goods, an industry which draws its raw material entirely from foreign sources, there is today invested in the United States about two hundred million dollars, and the total output of these factories is valued at three hundred millions. So, too, the American silk industry, with a capital of $210,000,000 and a production of $250,000,000, cannot continue to exist without its regular supply of silk from abroad. Time given, it might be possible to remedy this deficiency in the United States household, but it is doubtful that such a policy would really be in our best interest. This dependence is not limited to the two examples given; trying to avoid it would mean a vast program of economic change. Nor is it necessarily a disadvantage to a country to have to go abroad for raw materials not produced at home. Such a necessity offers the opportunity to create a commercial exchange which redounds to the net benefit of the national producers. An extreme instance of this is seen when England buys cotton from us and sells us back the finished fabric. She submits to the necessity of getting her raw material here, and makes that necessity a means for keeping her factories going at our expense. And even when the exchange is not on quite so extraordinary a basis, the buying of raw materials abroad is bound to create some market for home manufacturers.

But we started to inquire where the United States would stand in the world's markets at the close of the war. The principal products which we produce in insufficient quantities or not at all, and which we accordingly have to import, with the figures in millions of dollars for a normal year, are coffee 118, hides 117, sugar 103, rubber 101, silk 84, tobacco leaves 35, wool 35, cotton of certain grades 22, nitrate of soda 20. The values as given constituted one-third of our total imports for 1913.

At the same time we are of course selling to other countries many commodities which they cannot produce or manufacture, and the purchase of which is no less important to them than is that of the nine items mentioned above to us. The most prominent of these are cotton 547, manufactures of iron 304, bread stuffs 211, meat products 153, copper 140, mineral oil 126, wood and manufactures thereof 115, coal 65, tobacco and manufactures thereof 55, cars and automobiles 54, manufactures of cotton 53, leather 42, agricultural implements 40, fruits 37, chemicals 26, paper 21.

These lists show how extensively our national economic life is affected by our relations with the rest of the world. It is out of the question that we voluntarily dispense with the benefits of this intercourse by any effort to keep all raw materials at home. But under the pressure of the great difficulties which will have to be met by the world after the restoration of peace we must have some definite, connected and continuous policy with regard to our foreign trade. To the question what this shall be there can be but the one answer that it must be a policy of give and take, of friendship for all who are willing to treat us fairly and squarely in reciprocation. As a nation we have always held that the great inheritance of the world should be open to all, strong or weak; and it is to our interest that this continue. The rule, however, must be applied with judgment. While the rich economic resources of our country should not be withheld from the deserving, they should be protected from further waste.

In a previous discussion it has been seen that we may expect the war to be followed by several years of great economic activity, which in turn will lead to a period of depression continuing for some time. It is necessary that the United States prepare for both eventualities. The present mobilization provides for approximately two million men. Not all come from civil occupations. Nevertheless the withdrawal of so many from a total number of wage-earners, male and female, of 40,000,000 may well make itself felt in national production. The main advantage of the selective draft is that it distributes the withdrawals over all classes and that it retains men in occupations where they are needed for carrying on the war.

The unavoidable implication is that production will suffer in all other industries. This will be even more the case since the war industries constantly attract labor from other fields. It is, therefore, practically certain that production in many lines will decline and that, should the war continue for any time, this falling off will make itself severely felt in the market. The United States will accordingly enter the post-bellum period in a position differing from that of the other countries only in that the process of industrial derangement will not have gone quite so far. And as many of the industries most seriously affected by the displacement of labor are just those the products of which may be most needed when peace comes, there must be made early arrangements for a return to full productive capacity. A redistribution of labor and materials within our own boundaries must necessarily precede any attempt to bring aid to others. And perhaps the governmental control which has been found necessary for prosecution of the war might be taken as setting a precedent for putting this redistribution in the hands of some body with the power to make it an effective one.

Of the raw materials which are running low in Europe and which it is especially within the province of this country to supply, cotton and copper are easily first. With Germany and her allies practically emptied of these and with the Entente Allies running on a very close margin, it is to be expected that the demand for both will be very large from the moment of peace. We might in the first year after the war be able so to increase production as to meet this demand; but the wisdom of such a step is doubtful. We may well hesitate to have thrust upon us a one-sided productive activity without first being assured of the soundness of its economic basis. If the predictions of an ultimate period of depression are correct—and they can hardly be otherwise—this would mean that the world, including the United States, must guard against a sudden break in the markets. With such a possibility in view an extension, for instance, of our cotton production too far above what could be sold under normal circumstances might easily lead to a serious smash. The experience of 1914 has taught our cotton growers what this means to the South.

What applies to cotton applies to practically all the products exported by the United States. It really seems as though the safest and most helpful measure would be the initiation, right now, of steps to increase production of these commodities to the extent where we would have a small but healthy surplus which, after the war, might be employed to relieve the immediate needs of other nations. Such a policy would eliminate the necessity for a sharp, forced increase after the war, and minimize the danger of a loss in consequence of a sudden drop in the demand. In particular this suggestion would recognize that increased production, once undertaken, cannot be dropped like a hot potato. If we are to have it the first year after the war, we must have it for several years thereafter; otherwise the cost would be prohibitive in the first place.

Once having made sure of regular flow of supplies from the United States, we shall next have to consider how to secure permanency in the supply of those materials which we are accustomed to buy from abroad. The rubber industry, the silk mills, the tanneries, the wool spinners, must all be assured of receipt of the raw materials indispensable to their work. While it lies in our power to regulate production within our own boundaries, no means exists to induce other countries to follow the same provident policy. Regular production of rubber has been made more secure since the initiation of the plantation system in the Asiatic East than it was in former years when entire dependence was placed in wild rubber. The supply of foreign hides, however, rests on a less secure basis. Here extensive buying by Europe may unsettle the market even more than is now the case. And all raw materials the supply of which is irregular or limited will be similarly affected. Moreover, in many cases there will be not merely the question of production, but the additional problem of making the producer supply us when there are other demands nearer his home.

Should there follow, as has been suggested, a system of apportionment of raw materials for a certain period after the war, this problem would be solved and no one would have any just complaint. The United States would take pot luck with the others. On the other hand, if the world is left to work out its own salvation, a policy will have to be inaugurated for the prevention of any wilful discrimination. Such a policy should secure to the American consumer a guarantee that he shall be able to buy his fair share of the world's products wherever he likes at a price and under conditions as favorable as those extended the consumer from any other nation.

In the conduct of that policy the United States will be supported more than ever by the changes that have taken place in the world's markets since the war. Europe, with rising taxes, with higher wages, with higher prices for materials and food, will not be able to manufacture as cheaply as before the war. This will affect Germany as well as England and France. The American exporter will therefore meet the European merchant in third markets under much more favorable conditions than in former years. If all else fails in the endeavor to secure fair play we shall have to brandish the big stick. Our products are, on the whole, more essential to others than are theirs to us; and in the last ditch of necessity there is hardly a nation to which the threat of reciprocity of a sort not ordinarily implied in the use of this word would not be a serious matter.

It is especially to be hoped that after the restoration of peace we shall be able to do our own carrying. While the independence which this would imply would be an enormous advantage as compared with pre-war conditions, there is also thus created a factor in international shipping which must exert considerable influence on the whole world's commercial situation. Most likely the United States will use the new merchant ships preëminently for our own carrying. These ships, however, will have to carry the goods of other nations, they will have to visit the ports of other nations and use the facilities there provided for shipping. American ships have done this before the war; but there is a marked difference between the methods needed for handling such a merchant fleet as we had before the war and those necessary when that fleet shall have assumed the proportions which are planned for it. This fleet will alter our whole position as a merchant nation of the world, it will necessitate changes in many of our commercial treaties, and—paradoxical as it may at first glance seem—it will make us less independent in our treatment of the merchant ships of other nations in our ports. We shall have a new spot vulnerable to that big stick policy which we may expect to be rather common in international commerce for a while after the war.

There is one factor which deserves the attention of all those interested in the future development of our foreign commerce. Of our exports in 1913 crude materials constituted 30 per cent, foodstuffs 21 per cent, intermediate manufactured articles for further use in manufacturing 17 per cent, and manufactures ready for the consumer 32 per cent. Of England's exports, on the other hand, only 7 per cent were foodstuffs and only 14 per cent raw materials, the balance manufactures; while but 10 and 11 per cent of Germany's shipments were composed, respectively, of food and raw materials. We are, therefore, exporting a considerably larger proportion of foodstuffs and raw materials than the other two of the leading nations.

After the war the countries which will come out least affected will be the agricultural states outside Europe, especially those of South America. These will be the markets most desired by all other countries. But the United States by exporting great quantities of foodstuffs and agricultural raw materials is under a double handicap in seeking this business. The nations in question are our keen competitors in the fields mentioned, and will hardly find it most natural to buy of us in other fields. And in addition the United States manufacturer striving to do business there will not be able to buy of the products of the country and thus eliminate the necessity for being paid in cash—a great inducement which Europe can freely hold forth.

The inability of the United States to absorb much of the food products offered by countries having a preeminently agricultural development is one of the main obstacles to the expansion of the sale of American goods in these countries. The only way out would be the establishment in these markets of American houses which, while selling our goods there, could also assist in the distribution in Europe of the native products; and we can imagine the great coöperation which the European governments would extend to such distribution!

The part of the United States in international business has for a long time been only that of a buyer and seller of merchandise for its own use or of its own production. It will now add to its activities the transportation and commercial distribution of the products of other countries for the benefit of third parties. It is this aspect of our commercial policy—on its very face one possessing far-reaching ramifications never heretofore dreamed of by our statesmen—which will have a dominant influence on the economic future of our country.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

German Efficiency and the Soul

To the Editor of the SCIENTIFIC AMERICAN:

I think most of us have been confronted with the trying situation of being wrought to a high pitch that could only be relieved by a verbal explosion, and of finding that there were no words in our vocabulary that would fit the case. This has been my predicament for months, whenever the actions of the Prussian high command came up for discussion.

I wish to thank you repeatedly for your able editorial in the current issue, under the caption "German Efficiency and the Soul." I strongly commend it to all thoughtful readers.

ROBT. G. PILKINGTON.

Chicago, Ill.

To the Editor of the SCIENTIFIC AMERICAN:

I wish to express to you my appreciation of the leading editorial in your issue of November 3d, entitled: "German Efficiency and the Soul." This is *literature* and a war classic which should not be permitted to find oblivion in the files. In the mass of materials, current and official, which I have read and which I am still reading concerning the world-war, I have found nothing which puts the case so powerfully. You have put your "finger on the right spot" as we say in hospital parlance and disclosed the very seat of this murderous, conscienceless determination on the part of the Prussian to dominate the world.

This editorial might well be a section in a brilliant sermon by some pulpit orator; but if uttered by a clergyman this thought and this language would have attracted little, if any attention, because prefunctory and professional. Here we have *scientific preaching* which will haunt the memory of men who are untouched by theological or philosophical appeals from the pulpit. This is a great piece of writing and the man who wrote it may be assured that he has said something worth saying and said it after a great fashion.

C. C. BATEMAN,
Chaplain 14th U. S. Cavalry,
(Senior Chaplain U. S. Army, Active List)

Headquarters 14th U. S. Cavalry,
Del Rio, Texas.

The Super-Submarine a German Bluff?

To the Editor of the SCIENTIFIC AMERICAN:

I believe that the gas-engine drive for submerged submarines is nothing but a German bluff; and, referring to the article in your issue of August 25th, just arrived in Italy, I beg to hand you a clipping from the local paper, *La Tribuna*, containing an article written with this point of view by Professor Serono, one of the leading Italian chemists.

Referring to the letter, "The Torpedo Battle-Cruiser," I would remind the writer:

1. That the first torpedo cruiser ever constructed was the "Pietro Micca" of the Royal Italian Navy, some forty years ago.

2. That General Cuniberti, naval architect of the Royal Italian Navy, and inventor of the dreadnought type of battleship, some time before his death proposed a semi-submersible torpedo battle-cruiser with a whole battery of torpedo tubes.

ETTORE BRAVETTA,
Rome, Italy. Rear Admiral, I. R. N., Retired.

The clipping which Rear Admiral Bravetta sends us will, we believe, interest our readers, so we give the following abridged translation of it.—THE EDITOR.

In many journals, both Italian and foreign, there have appeared descriptions of a new German submarine of unprecedented tonnage, drawn from the meagre details which the Germans have allowed to become known in the hope of influencing neutral sailors. This super-submersible is alleged to have an entirely novel engine, burning crude oil, running normally during surface navigation and through the agency of compressed oxygen when submerged. In reality this engine is said to be six Diesel engines combined in one, each unit being of a thousand horse-power and the combination accordingly of six thousand.

Of course the idea is that when the boat is submerged oxygen is fed the engine from tanks, and that the oil burns, using this oxygen, and forming carbonic acid gas and water, as always. The former would be collected and fixed by passing it over vessels containing milk of lime—slaked lime suspended in water. This keeps the atmosphere of the boat in breathable condition. Now, however ingeniously this idea might be worked out, the bald facts are that it is not practicable, because of the enormous weight of the reservoirs of oxygen, of lime and of oil which would have to be carried for a cruise even of five days—a weight wholly in addition to that of the submarine itself. To make this clear it will suffice to examine the operation of an ordinary submarine of 1,000 tons. Such a one is ordinarily equipped with two crude oil motors of a combined rating of 2,000 horse power. The consumption of oil per horse-power-hour is 0.270 kilograms (0.595 pounds), so that the generation of 2,000 horse-power for 24 hours would call for $2000 \times 24 \times .270$ kilograms —12.96 metric tons of 2,000 kilograms or 2204.6 pounds.

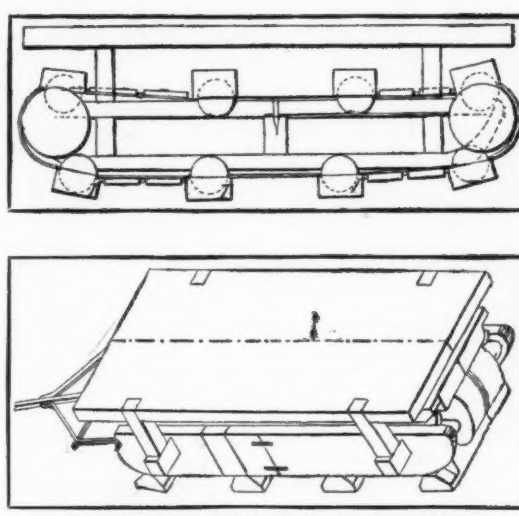
In general a submarine of this sort will have storage space for 65 tons of oil, which as far as fuel is concerned will support continuous surface or sub-surface navigation for five days. But when the vessel runs submerged, in addition to the direct fuel requirements, it is necessary to carry oxygen for the crew and milk of lime to purify the air. If in addition to the normal requirements, we attempt to install a gas engine drive for running submerged, we must of course be prepared to furnish oxygen to this engine as well as to the crew; and to the bad breath of the humans we add the bad breath of the engine—so more lime is necessary.

It will be seen that under no system of operation can a submarine have any very great range of action, except by increasing its storage space at the expense of its military efficiency. Even supposing that it remains inactive many hours each day, after ten days at the most it stands in need of replenishment, and after fifteen or twenty days it must return to its base for the necessary overhauling of its complicated mechanism.

Accepting as true, for the moment, the German claim of a submarine that functions, when submerged, by means of crude oil engines instead of batteries, let us inquire what dead weight would have to be carried to make possible a voyage of at least ten days without renewal of supplies—ten days of which at least two are spent beneath the surface. On the basis of the figures previously given, 6,000 horse-power will use up 39 (metric) tons of oil per day, or 390 for the ten-day voyage; and of this amount 78 tons will be consumed while the ship is submerged. Now a kilogram of crude oil (2.2046 pounds) requires, for its complete combustion into carbon dioxide and water, 3½ kilograms of oxygen; so the burning of our 78 tons of oil will require 273 (metric) tons of oxygen. This oxygen, at ordinary pressure, would occupy a space of about 191,000 cubic meters—250,000 cubic yards. So it would have to be compressed. A cylinder containing five kilograms of oxygen at 150 atmospheres would have to be a mass of specially forged steel weighing not less than 60 kilograms (132 pounds). At this rate, to carry the 273 tons of oxygen of which we have spoken there would be necessary 54,600 cylinders, with an aggregate weight of 3,276 (metric) tons—and this exceeds by 60 per cent the tonnage of the submarine that is to carry them! Besides, there would be necessary 468 tons of milk of lime at 50 per cent—a high figure—to absorb all the carbon dioxide formed during the operation of the engines.

Even reducing the assumed figures to half a day of submergence, the weight of the oxygen tanks and the lime to be carried would go beyond the ability of the submarine. And we have taken no account of the enormous temperatures developed by the combustion, which would suffice to melt the piston chambers, and even parts of the submarine itself.

For the present, then, the new submarine exists only as a bluff. We may concede that the Germans have introduced some mechanical improvements, have attained a speed heretofore impossible. But we may take it for granted that their latest submarines are fundamentally the same as all the other submarines we know; and our arguments against the gas-engine drive while submerged are then conclusive.



Patent drawings of the Lake crawler of 1867

The Crawling Tractor Fifty Years Ago

EXCURSIONS through the patent office files often bring to light surprising things. The most ludicrous ideas are found there slumbering, ideas put forward and patented in all seriousness by the single track mind that gave them birth. And now and again one stumbles upon the most unlooked-for anticipation of some highly modern device, an idea which had to be forgotten and invented all over again years later, when the world was better prepared for it.

In the latter class is United States patent No. 61,344, granted to Jesse S. Lake of Smith's Landing, N. J., under date of January 22d, 1867. The success of the British armored tank has led to a very interesting controversy as to whose idea the traction belt really is. In the presence of Mr. Lake this will have to take a different turn, and revolve about the question of whose suggestion it was that directly stimulated the British military engineers to take up the crawling tractor or caterpillar or track layer or whatever name be attached to the fundamental and easily recognized principle underlying the tank. For 50 years ago Mr. Lake built track layers that really ran and did useful work. Of course, they were not tractors, and could therefore go only where a horse could precede them; but track layers they certainly were, as is made plain by the drawings which we reproduce from the Lake patent and by the following comprehensive description and claims quoted from the same source:

"I have invented a new and improved Self Track-Laying Car for common roads. The object of my invention is to furnish a car for common roads that will lay its own track, thereby enabling it to carry heavy weights, and be drawn with great ease.

"As the car is drawn by the team or other power, the runners pass over the wheels. Said runners are prevented from running off of the wheels by flanges, and as the car advances the wheels and floats are taken up in the rear of the car and carried ahead on the upper side of the runners, somewhat in the form of an endless-chain horse-power. To turn the car laterally out of its course, the team is caused to draw laterally upon the perch, carrying the outer ends of the flanges a little to one side, making a slight curve in said flanges; and the floats are caused to be laid a little out of a right angle with the course of the car, thus causing the car to move in a curved line.

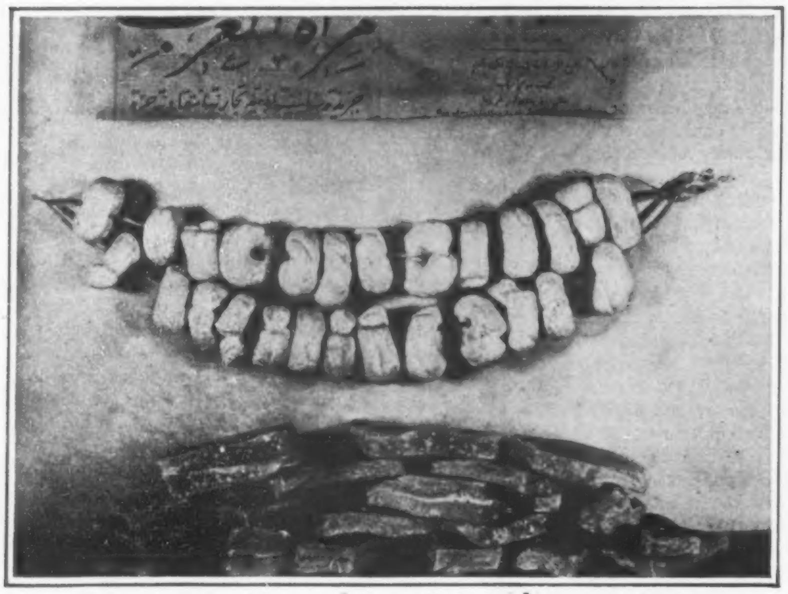
"I claim the combination, with a truck, car or vehicle, of the within-described revolving track, consisting of an endless series of trucks or floats, connected together by flexible chains, cords, or straps, and operating in the manner and for the purpose specified."

We are indebted to Dr. H. L. Harley of Pleasantville, N. J., for some details of Mr. Lake and his invention. He made several of these vehicles, and had them in operation about the village where he lived. His neighbors dubbed the thing "Lake's Hell Wagon" because of the clatter it made. The necessity that brought the Hell Wagon into existence was the difficulties encountered in building the Old Turnpike between Atlantic City, on the Absecon sand bar, and Pleasantville, on the mainland. Between these two, a distance of some five miles, is a stretch of soft meadows and shallow bays. A narrow tired wagon, even with the lightest load, would sink to the hub, so Jesse Lake set about to invent something that would overcome this; and the "self track-laying car" was the result of his labors.

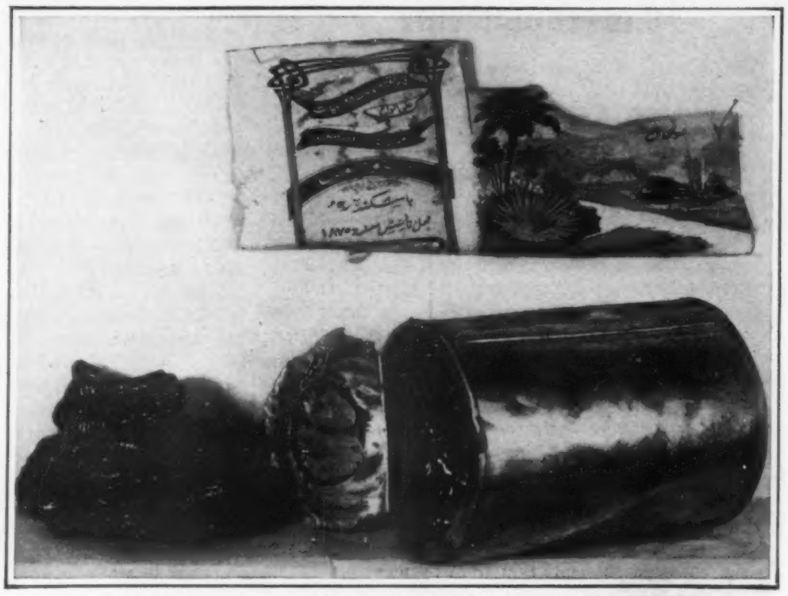
A Department of Agriculture Report of 1866 speaks enthusiastically of the Lake invention. The writer of this report saw the thing in use, and was certain that it was worthy of general introduction. After describing the now familiar principle of operation at length and in several different ways, in order to be certain of getting it across, he remarked that he saw a span of old plugs of horses that needed a whip to quicken them to a moderate walk, move off with comparative ease with a five-ton load of earth. The boys of the neighborhood often borrowed the Hell Wagon to bring their boats up from the bay for repairs, or to haul home a ton of coal. Either of these stunts could be performed by one boy with great ease and tremendous noise.

"Uncle Jesse" appears to have been a good deal of an eccentric. In his wonderful shop, which was dignified by the name of "foundry," could be found pretty much anything from a jeweler's screw driver to a mowing machine. He patented altogether over sixty inventions, and allowed many more to go unprotected or actually to be patented by others who abused the confidence with which he exhibited his ideas to them. Perhaps the most interesting item of all is that he mounted a steam engine and boiler on one of his Hell Wagons. The experiment was somewhat of a failure, not because of any wrong principle, but because of the lightness of construction of the carrier. The motive power shook the Hell Wagon to pieces.

Jesse Lake came of a family of inventors; Simon Lake, of submarine fame, is a cousin twice removed, and other members of the family have done business at one time or another with the Commissioner of Patents.



Below, Japanese rice sugar. Above, Turkish palm sugar (refined)



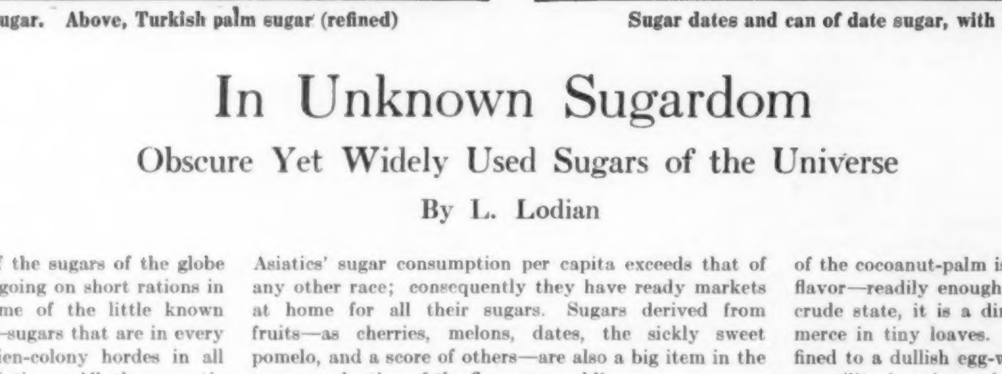
Sugar dates and can of date sugar, with Arab scene from label

In Unknown Sugardom

Obscure Yet Widely Used Sugars of the Universe

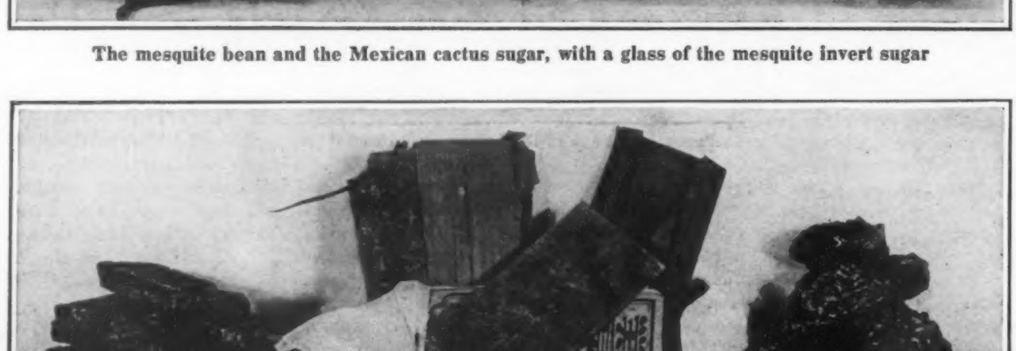
By L. Lodian

WITH a little knowledge of the sugars of the globe there is no necessity for going on short rations in this fundamental of diet. Some of the little known sugars are illustrated herewith—sugars that are in every case obtainable among the alien-colony hordes in all big American centers of population. All these exotic colonies have their importing groceries, and it is a striking example of the cosmopolitism of Manhattan that the sugars here shown were all purchased at retail stores within walking distance of the SCIENTIFIC AMERICAN office. In general, due to transport distances and shipping scarcity, they retail at an advance over local sugars; but the problem is often to get any domestic sugars at all.



The mesquite bean and the Mexican cactus sugar, with a glass of the mesquite invert sugar

Chinese sugars—sorghum bars (left), fruit sugar, and crystallized sorghum (right)



Maize sugars—granulated and block—from the western United States

After an ostracism of over forty years the old centrifugal raws of our grandmothers' days are showing up in force again in the grocery stores. They range in color from the old-time familiar "yellow sand" to a rich black brown. This last raw has the delectable molasses syrup still intact with the sugar; and if the black mass be placed in a gauze wire receptable in a moderately warm room, and allowed to drain, the rich molasses will continue to exude slowly drop by drop. These crudes are imported in barrels; and the sugar is often so compacted that it has to be chopped out with an axe or a spade. They are the grand base whence come those immaculately refined white sugars, which not so long ago were almost "as cheap as dirt."

It is little known that in times of sugar plenty, refined sugar is always made by the ton in cones, bars and sheets (about half the size of your desk blotter), and is always obtainable in these shapes. Such sugars are widely used in the trades because of their convenience in handling over small sugars.

Asia's annual sugar production exceeds twelve million tons under all heads—sorghum, palm-sap, fruit, cereal, etc. The sorghum yields the lion's share. In its commonest form it appears in sun-dried sheets and bars, of delectable caney flavor; and it is also obtainable in fist-size crystalized chunks, or as an invert sugar. The Asiatics' sugar consumption per capita exceeds that of any other race; consequently they have ready markets at home for all their sugars. Sugars derived from fruits—as cherries, melons, dates, the sickly sweet pomelo, and a score of others—are also a big item in the sugar production of the flowery republic.

The Mongols have no refined loaf or lump or cut sugars, but their crystalized massed sugars amount to the same thing, although slower in disolving. Some specimens are here illustrated. Such sugar refining has been practiced by the Orientals since antiquity.

The palm-sugars of Arabia and the Nile regions are of melt-in-the-mouth lusciousness. The thickened sap of the cocoanut-palm is the best, with its mild cocoanut flavor—readily enough detected by the expert. In the crude state, it is a dingy brown, and appears in commerce in tiny loaves. In some Oriental cities it is refined to a dullish egg-white; but the Eastern mind sees no utility in using a dash of synthetic blueing to render sugar a snow-white.

The date sugar of the Ganges delta and overland to Iran and Bagdad and Izmir is of two sorts—dry and hard, or a soft cheesy mass like the raisin and currant sugars of the Levant. The pasty date sugar is so cloyingly, sickeningly oversweet, because of its immediate diffusion through the mouth, that its use is perforce economical.

There are two kinds of dried dates. First, we have those always soft to the touch, yet dry and cleanly to handle, never being sticky. Then there are the stone-hard glossy dates, dry as a bone, with no invert sugar content. This date actually refines its own sugar in a measure; you find it ready crystalized in the hard mahogany-like date, which can be used direct for sweetening tea or coffee, the hot liquid leaching out the sugar.

The fig sugars of the Levantine countries are chiefly a farm or household article for domestic use. They are produced much as some Texas and Rio Grande farmers produce their mesquite-bean sugar—by crushing and evaporation of the syrup, the refuse being utilzed as a sweet stock-feed. Naturally the fig sugar is much the sweeter, compared with the mesquite sugar.

The singular Japanese rice sugar is made from malted rice, just as the malt syrups of the Western world are made from malted barley. It can be obtained in the form of hard and solid bars as illustrated, or as an invert sugar of crystaline transparency. The wheat and barley cereal sugars of Korea are further types of the Oriental grass sugars.

The potato sugar of the Germanic countries, both solid and invert, is less sweet and less satisfactory to use than our maize sugars; and the cereal product is displacing it even in its own country.

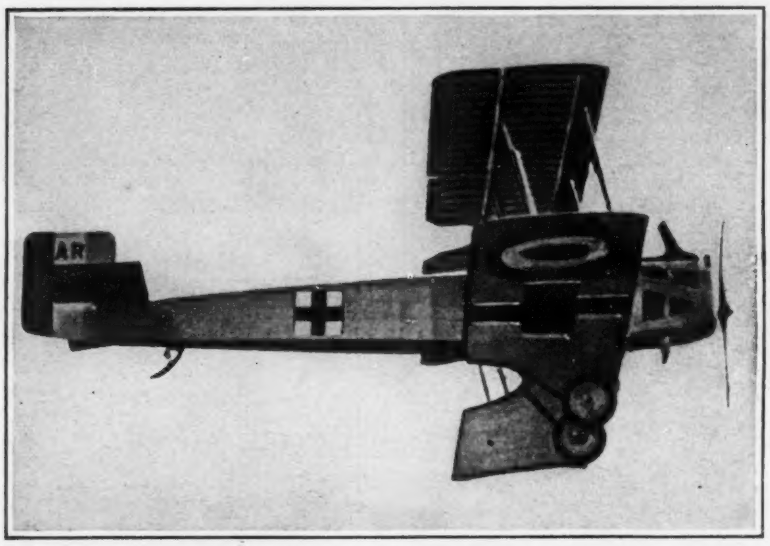
The mesquite bean invert sugar of Texas, Mexico and Hawaii is identical with the algaroba sugar of Spain and Portugal, and likewise with the karob sugar of Asia Minor and the regions overland as far as the southern portion of China. It is freely obtainable in Manhattan—freely, that is, in all senses but the financial—and occurs in commerce as a very heavy black-brown molasses, redolent with a concentrated sweetness combined with the odor and the mild bitterness of licorice syrup. It is a slightly aperitive sugar, like another tree sugar of the Levant and the Mesopotamian valley, called manit sugar, and obtainable either crude, like the karob sugar, or refined to a snow-white color and molded in little cones about the size of a goose egg.

By a singular customs-house classification the Mongol karob sugar is erroneously entered as soy, as of from the soy bean—an article which has no more saccharinity than an Irish spud. Being shown diverse specimens for an opinion, I instantly identified the batch as analogous to my old friend the mesquite sugar of the Rio Grande region and the southern Sierras—of happy memory in location days of yore, with their early morning tortillas, maize cakes, buckwheat flapjacks, fresh casava, etc. This mesquite sugar is often called black strap, due to its thickness and its tedious movement in cold weather—dawdling out of a container, almost motionless, suspended like the strap for which it is named.

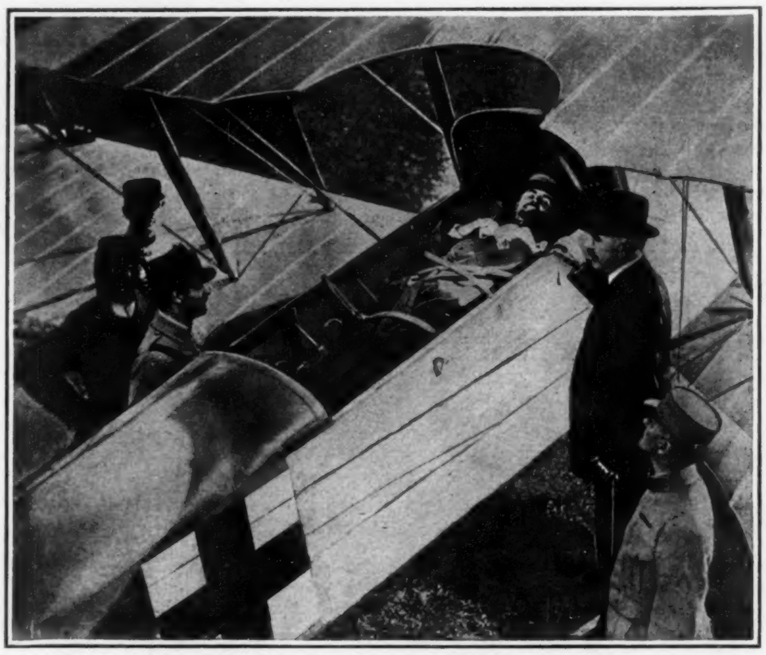
The so-called cactus sugar of the Mexican border dates from pre-historic times, and is still made. It consists of the cut and dried pulp of the cactus immersed in wild honey syrup and crystalized by the sun. It is ever dry and cleanly to handle, and almost as hard as rock sugar. It is intensely sweet, and can be used as a sugar or a sugar candy.

The maize sugars (sometimes called corn sugars) of the western United States have been obtainable for many years either in bars or granulated or in the confectioners' flour form. In periods of sugar scarcity they are a great help in the household, as but half the customary amounts of cane-sugar need be used for such purposes as preserving. These cereal sugars are less sweet than sorghum or cane or fruit sugars, but their food value is about the same.

There are some score diverse sugars of the globe sold in normal times in a vast emporium like Manhattan, among the groceries of its hybrid citiesful of exotics. About half of them are featureful and characteristic; and these are shown with this article. The other half are featureless and non-photographic—"nothing to see," in the words of the artist. However, the chief thing is, they are obtainable. Look around for them!



The aeroplane-ambulance in flight over the Villacoublay aerodrome in France during recent tests



Strapped in place and protected against wind and cold, the seriously-wounded passenger is comfortable aboard the winged ambulance

Carrying the Seriously-Wounded to the Hospital Via the Air Route

RECENTLY the French authorities conducted interesting experiments with an aeroplane-ambulance at the Villacoublay aerodrome. The use of aeroplanes as ambulances had been advocated by Dr. Chassing, Deputy of Puy de Dome, for some time past; but this was the first practical test of a true twentieth century means of transporting the seriously-wounded to base hospitals via the air route.

In the two accompanying illustrations appears the aeroplane used in the Villacoublay tests. It will be noted that the aeroplane, which is of a standard design, has been only slightly modified to serve as an aerial ambulance. The main modification consists in providing a longer open space in the fuselage than usual, so as to serve as a bed for the wounded passenger who is strapped securely in place. At the head of the wounded passenger, or just in back of the pilot, is a windshield which wards off the rush of air, while ample blankets and other covering keep him warm during the flight.

Traveling at 80 miles an hour, the aeroplane-ambulance is said to be free from shocks and vibration, which are troublesome factors in the usual vehicles for the wounded. And in order that the winged ambulance may not be subjected to the enemy's anti-aircraft fire, it is planned to fly at only 500 feet, so that the Red Cross markings of the machine can be plainly seen from the ground.

The Current Supplement

AFTER the war, when affairs begin to settle down, many undeveloped parts of the world will attract attention not heretofore given them, both for economic reasons, and as objective points for many men, who, having experienced the excitement of a strenuous life at the front, will not be inclined to settle down again to the confinement and monotony of the office and the shop. One such region is the *Belgian Congo*, in relation to which considerable information was recently given in an address before the Royal Society of Arts, London, extensive abstracts from which will be found in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2186, for November 24th. Another instalment of the interesting papers on *Anomalies of Animal Life*, accompanied by illustrations, appears in this issue. *Electro-Culture of Crops* reviews recent developments looking toward artificial stimulation of plant growth. *Junk America's Richest War Bride* tells of the tremendous demand that exists for discarded material, and how some of it is utilized. It is an amazing story of waste and extravagance, illustrated by a number of suggestive photographs. *Medieval Mason's Marks and Grafitti* tells how the ancient artisan vouched for his work, and is accompanied by numerous illustrations. *Designing and Constructing a Clock* describes and illustrates a simple time-piece within the capacity of any good mechanic that compares favorably with an expensive "regulator." There are several explanatory drawings. *The Human Factor in Railway Electrification* tells how electrical locomotive engineers are made out of steam locomotive engineers. Other articles include *The Relation of Chemistry and Mechanical Manipulation to the Evolution of the Glass Industry* and *The Autumn Moon*.

Those Adventurous British Tanks

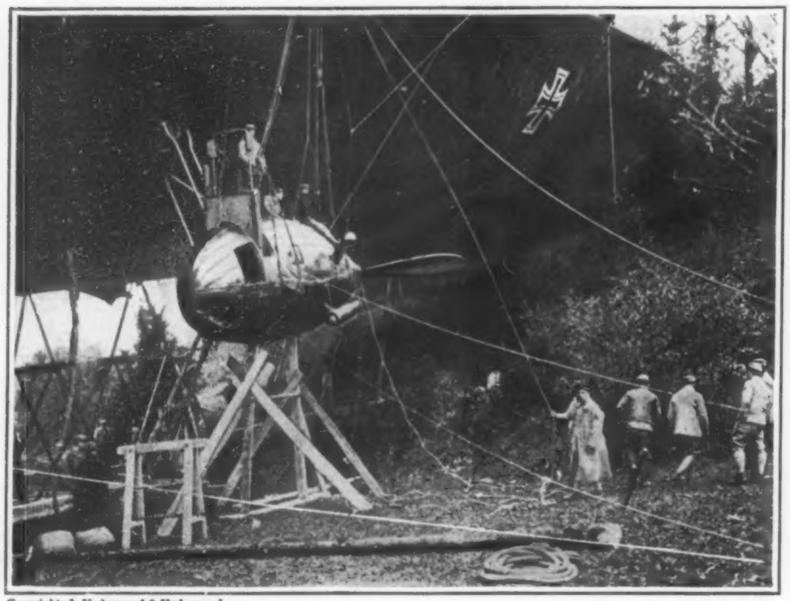
READING of the hair-raising adventures of the British "tanks" in France and in Flanders, the American public had naturally come to look upon this latest instrument of warfare as a thing of gigantic proportions. Artists had pictured the tank as a huge traveling fort, bristling with heavy guns. At any rate, it was with much surprise that New Yorkers beheld a British tank, the "Britannia," crawling along Fifth Avenue during the recent Liberty Loan parade—with much surprise because the tank was far smaller than they had anticipated.

The accompanying illustration is of interest in this connection because it proves once more that the British tank is not the gigantic machine which lives in the minds of most of us. Indeed, a man looms up big alongside the tank, and after the propelling mechanism has been taken care of as well as the armament, it is evident that the crew's quarters are somewhat limited aboard the landships.

But small size has not prevented the British tanks from accomplishing all that was expected of them. We have been told that British tanks, during the last engagements constituting the Battle of the Somme last year, penetrated far behind the German lines. Once a lumbering tank ran into a small locomotive used on one of the supply railways in back of the British lines, and bowled it over to the amazement of the train crew and the tank crew. On another occasion a tank was attacked by a German airman, who flew about the steel monster as he poured machine-gun fire against its sides and roof. After exhausting his ammunition he flew away, evidently realizing that the monster's hide was too tough for his light armament. Down in Palestine the British tank has made its appearance, and the Turks, like their German allies, have been unable to deal with it. Of course, artillery can deal with the tank, but the British have taken care of that by making their tanks as little visible as possible by clever camouflage methods.

An excellent idea of what the caterpillar tread of the tank is like can be obtained from the accompanying illustration, which clearly shows the odd tractor belts.

A British "tank" in Flanders: Note the comparative size of the tank and members of its crew



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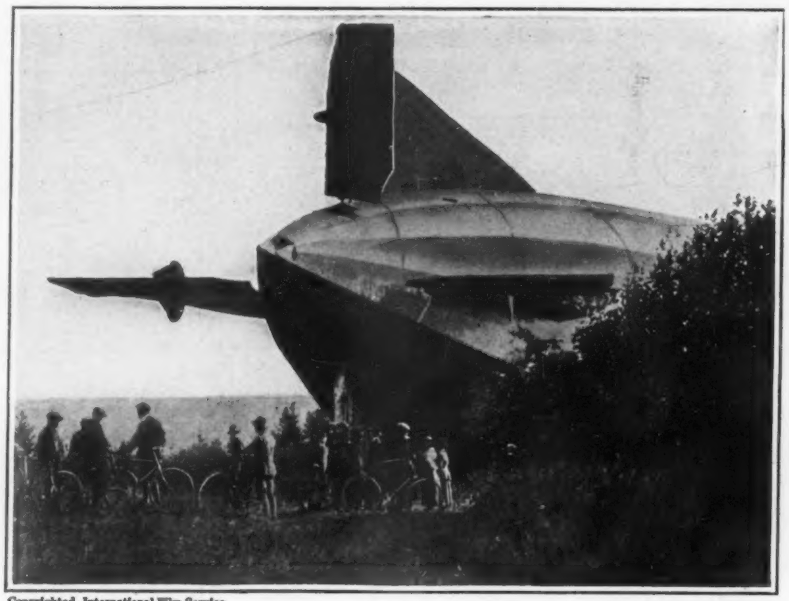
One of the five separate power units of the Zeppelin L-49



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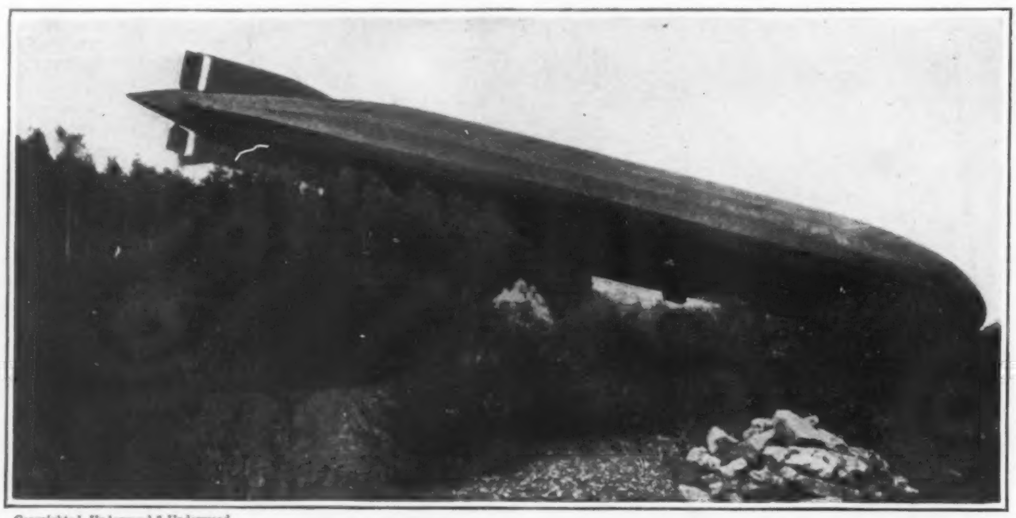
The tail of the Zeppelin, showing the rudder and elevators

Some Super-Zeppelin Secrets

What the Allied Aeronautical Experts Have Learned From the Zeppelin L-49 Brought Down in France

HAD the German commander of the Zeppelin L-49 been more successful in aiming the shot with which he intended to destroy his craft, after a forced landing on French soil following an engagement with a French battleplane, he would have reduced the aerial leviathan to a mass of twisted aluminum and shapeless lumps of equipment. But his inflammatory bullet missed a balloon unit by a few feet, and before he could fire again a retired French soldier "covered" him with a shotgun. In this manner the L-49 fell into the hands of the French and other Allied aeronautical experts practically intact; and thus all the secrets of the super-Zeppelins are now available for the first time.

Reports state that the L-49 is evidently a recent type of Zeppelin, probably one of the many turned out in 1916, and intended for scouting out at sea and for raiding purposes. Much credit is due the designers for the care and the skill displayed in the arrangement of the craft as a whole, and in the treatment of minor details. But the construction in general impresses one with a sense of hasty workmanship, for there is much of the makeshift order in evidence. In fact, this bears out the rumor that the Germans for some time back have reduced the Zeppelin to a standardized manufacturing proposition, and that many of the aluminum and other metal parts are stamped out in large numbers at various plants and assembled at the airship factory proper. However that may be, the tendency toward eliminating the finish on everything where finish is not essential appears to be spreading in Germany; in the enemy's aeroplanes, for instance, the finish has been noticeably declining in captured models, and the comfort of the airmen appears to be the least consideration of the designers and the constructors. So, with the Zeppelins, it is more than likely that finish and the comfort of the crew are being sacrificed for fighting efficiency, which, in the raider type, means shaving off every pound of weight possible in order to increase the bomb-carrying capacity.



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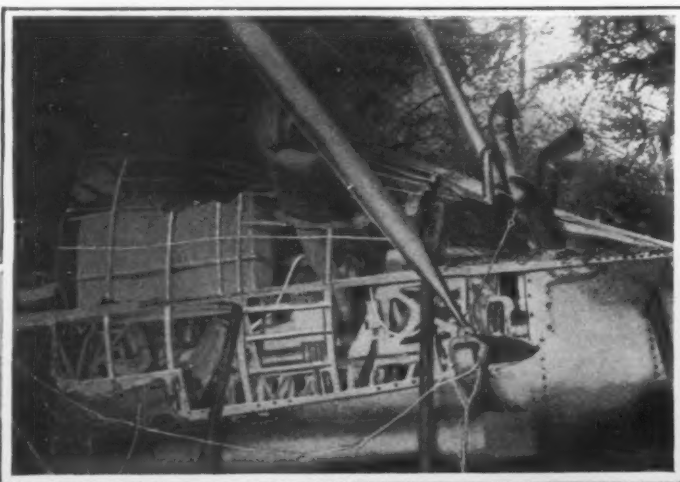
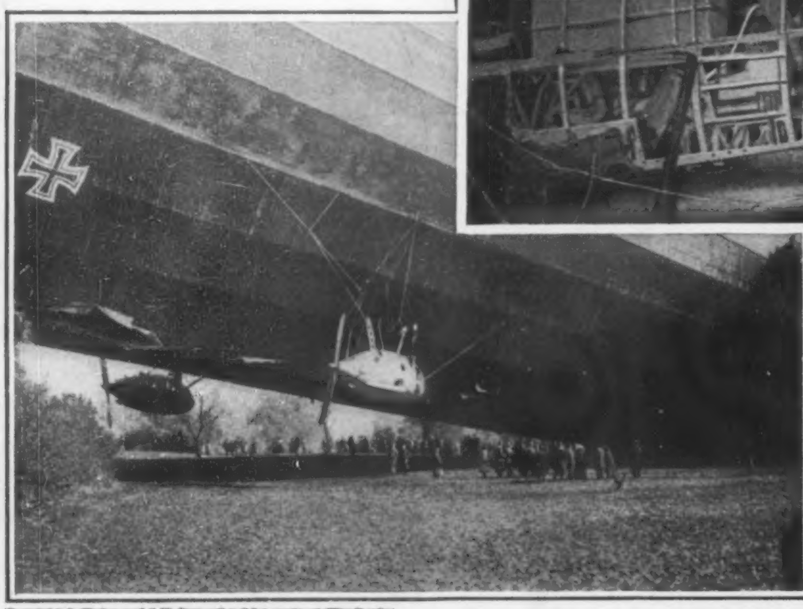
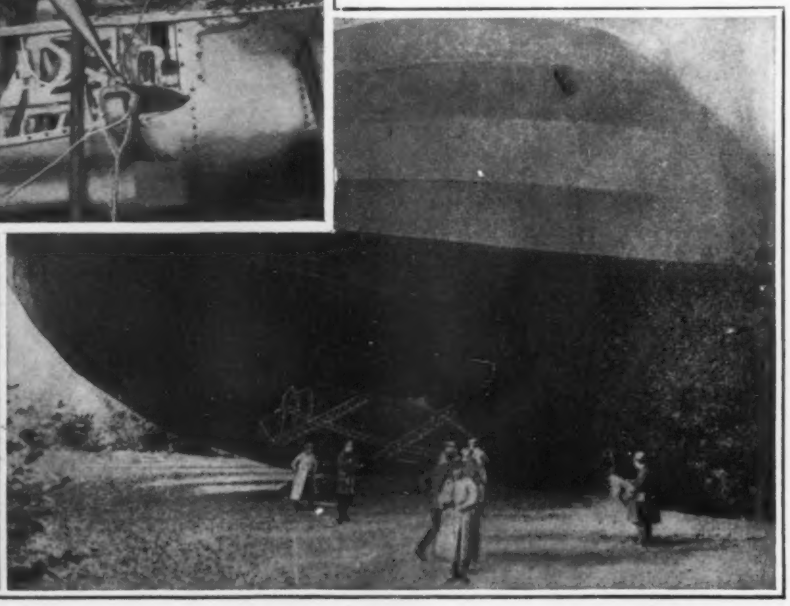
Zeppelin L-49, brought down intact by a French airman, resting on a hillside near Bourbon-les-Baines

Like most other Zeppelins, the L-49 carries a powerful wireless set. Indeed, the wireless room is ostensibly one exception to the rule of makeshift construction, and in a general way it is strongly suggestive of the wireless room of an ocean liner. French officers who have examined the wireless apparatus state that no new principles are involved, although there are many novel features of much interest. And despite the fact that the wireless apparatus was damaged by hammer blows before being abandoned by the operator, it is held that Allied experts will be able to reconstruct it without undue difficulty.

(*Concluded on page 392*)







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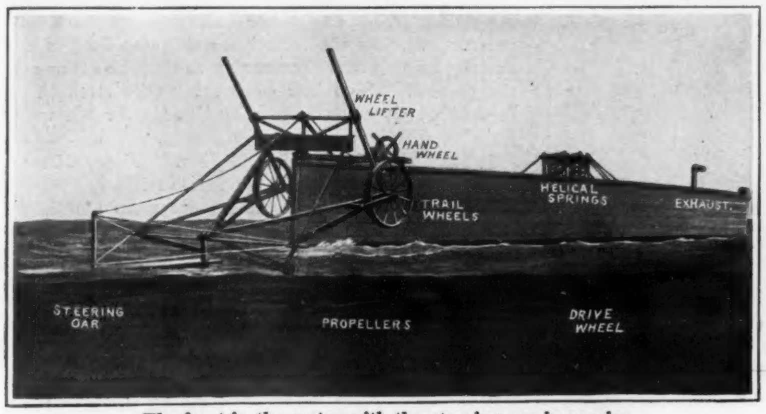
Above: One of the wrecked gondolas or power units, showing the engines. *At the left:* Two of the gondolas or power units of the Zeppelin, each containing two engines. *At the right:* The nose of the giant airship, showing part of the aluminum framework exposed by a slight tear

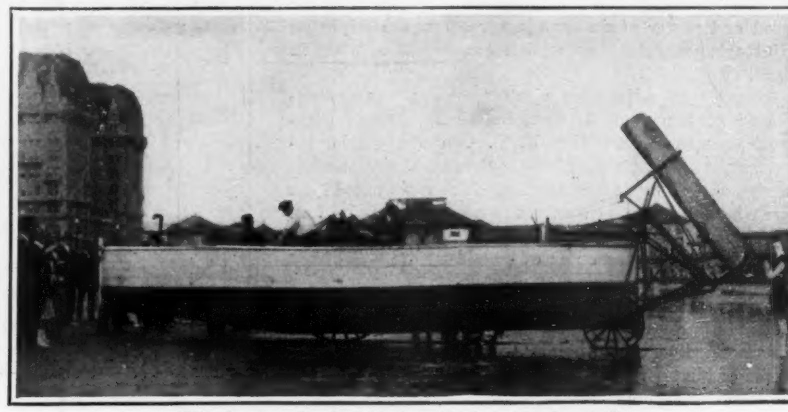
Some constructional details of the L-49, which are now available for the first time through the failure of the crew to destroy their craft

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



The boat in the water with the steering oar in service



The boat on land with the steering oar elevated

A Life Boat That Can Run on Land

A CURIOUS craft has made its appearance on the beach of Atlantic City. It is a boat that can run up on the hard sand and travel over the land, albeit rather clumsily. This, however, is to be expected, because after all, the water is its natural habitat and its incursions on land are only occasional.

When on land the boat travels on a tractor wheel 20 inches wide and 54 inches in diameter, while it is steadied and steered by two trail wheels aft. The tractor wheel is carried in a well and projects six inches below the bottom of the boat. A 35-horse-power motor drives either the propeller or the tractor wheel. It is located well forward and turns a line shaft which is geared to an athwartship jack-shaft. The tractor wheel and the propeller shaft are connected with the jack shaft by means of gears and jaw clutches. There is a spring connection between the tractor wheel and the hull to take up shocks that might be felt on an uneven beach. The craft enters the water stern first, until afloat, when the steering wheels are lifted out of the water and a steering oar is brought into play. The accompanying illustrations show the oar and the steering or trail wheels in two positions.

The inventor of this interesting craft is Rear Admiral John A. Howell, retired. His purpose in building this amphibian boat is to provide a craft which may be of value not merely for taking excursionists out through the surf, but also for life saving purposes. Being an automobile boat it dispenses with a large crew and is much more powerful and of greater capacity than the usual life boat. Admiral Howell believes that it can also be used for coast defence, and as a tender for sea-planes. Furthermore, he considers it superior to other boats for handling troops on open coasts. Admiral Howell has been experimenting with amphibian boats for many years and this is his third and latest model.

Running the boat up on the beach

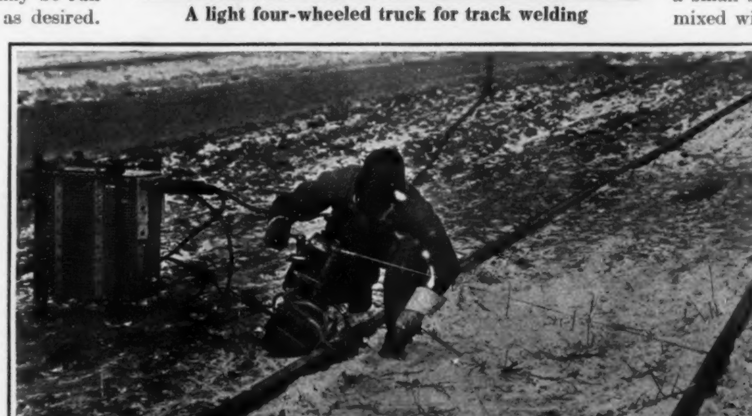
A Liliputian Outfit for Welding Rail Bonds

THE electrically welded rail bond is demanded by good electric railway practice but the elaborate apparatus heretofore called for has put the process out of the reach of the smaller companies. A bit of apparatus weighing less than three hundred pounds has now been perfected by which the work of installing a rail bond is performed with the same efficiency as by a rail bonding outfit weighing twenty times as much. The apparatus consists of a rheostat weighing about two hundred pounds and a welder weighing about sixty-five pounds. These may be carried by convenient handles, or a single wheel placed under the rheostat will permit of its being wheeled along the track; but the most convenient way of handling the outfit has been found to be that of mounting the parts on a four-wheeled lorry and this may be run along the tracks from one point to another as desired. This arrangement permits the use of two welders, one mounted on either side so that work on either track may be done without the necessity of shifting the apparatus from one side to the other as required where only one welder is available.

This entire combination may be readily lifted from the track by two men to permit the passage of cars. The portable welder is operated from the trolley wire direct, working at any voltage from one hundred and fifty to six hundred, which takes care of the extreme fluctuation in line voltage which may be met in the field.

By the use of this outfit an electrically welded bond is obtained with a contact having an initial high conductivity and one which it is claimed will not depreciate because of the elements or like exposure. In obtaining this union between the rail and the bond neither arc nor flame strikes the parts, and thus the danger of injury to the bond, the rail and the eyes of the operator is avoided. Instead, a heated block of graphite presses against the bond terminal and makes the union of the metals. The apparatus is held in position for service by a yoke placed over the head of the rail and a chain and hook fastened to the opposite rail. This holds the welder in a tilted position so that a portion of its weight presses against the bond. Two hand wheels on the framework are provided to adjust the tilt and vertical position so that the surface of the graphite will come into plane contact with the bond terminal.

A light four-wheeled truck for track welding



The latest apparatus for welding a rail bond

Substituting Coal Gas for Gasoline as a Fuel for Automobiles

IN consequence of restrictions on the use of gasoline for motor vehicles, coal gas is now being utilized as fuel to an increasing extent. It is reported that the new scheme was started in Manchester, England, and the success of the first experiments was such that the idea has been widely adopted. In the commercial part of Lancashire steps are being taken to provide charging stations so distributed that vehicles need never be more than five miles from a fresh supply, while the movement is similarly spreading throughout industrial Yorkshire, and in Glasgow it is meeting with appreciation. The project was indorsed at a recent meeting at Nottingham of the Motor Trades Association. It is anticipated that garages throughout England will soon be in a position to supply recharges of coal gas.

In view of the development, considerable attention has been given to the construction of suitable containers. The use of steel tanks has been generally abandoned, as the strength required to compress 250 cubic feet of gas—the amount required to equal a gallon of gasoline—could be supplied only by tanks weighing more than 500 pounds. Another disadvantage of the compression was the attendant likelihood, in low temperatures, that the gas would turn to liquid. The ordinary arrangement now consists of a gas bag made of balloon fabric fastened to a light wooden rack on top of the car. A supply pipe usually runs down the edge of the wind shield on the carbureter side of the engine and discharges the gas directly into the carbureter or into the intake pipe near the carbureter. The danger of a back flare is obviated by a check vale, or vice versa.

In this same pipe, back of the check valve, is a connection for the gas-supply main to be used when the gas bag is filled—an operation requiring about ten minutes.

It is admitted that an engine driven with coal gas develops about 90 per cent of the power that is obtained when it is driven with gasoline, and that to get the best results the engine must be driven at a high speed. It has been suggested, however, that an arrangement by which a small supply of acetylene gas could be regulated and mixed with coal gas at the carbureter would strengthen the explosion and supply the necessary "kick."

A Priestley Memorial

A COMMITTEE appointed last year by the American Chemical Society to consider plans for a memorial to Joseph Priestley, the discoverer of oxygen, has recommended that a bust portrait of the pioneer chemist be secured and deposited in the United States National Museum, but remain the property of the society; also that a gold medal be offered at intervals for distinguished achievements in chemical research, with the requirement that the recipient deliver an address before the society. Reared in England, Priestley passed his last ten years in America, dying in Northumberland, Pa., in 1804.

An Aeroplane Propeller Whose Pitch May Be Varied While in Actual Flight

AT the present time the speed and power of an aeroplane are controlled by regulating the speed of the engine. While this method suffices, it is of necessity a crude one, since there are certain limits of speed between which an aeroplane engine does its best work. All of which means that the ideal method of controlling the speed and power of an aeroplane resolves itself into an adjustable propeller whose pitch can be varied while in flight.

Recently an adjustable pitch propeller was demonstrated at Long Beach, Cal., before a party of aeronautical experts, including E. L. Graham, official inspector for the United States Government, stationed at an aircraft factory in Los Angeles. The main part of the invention lies in an adjustment in a new steel hub of an aeroplane propeller, by means of which the pitch of the blades may be increased or decreased at the will of the pilot, at any time. This may be done while the propeller is racing at top speed. Low pitch will allow the machine to speed up when starting from the ground, and when the craft is lifted well into the air, an increase in pitch of the propeller blades will increase the speed of the machine. Automobilists know how difficult it is to start in high gear. Heretofore there has been no opportunity for changing the pitch of propeller blades; and in cases where a sharp pitch propeller is used to equip a high speed aeroplane, great difficulty has been met in getting a quick start. With the new propeller, however, the difficulty is believed to have been removed.

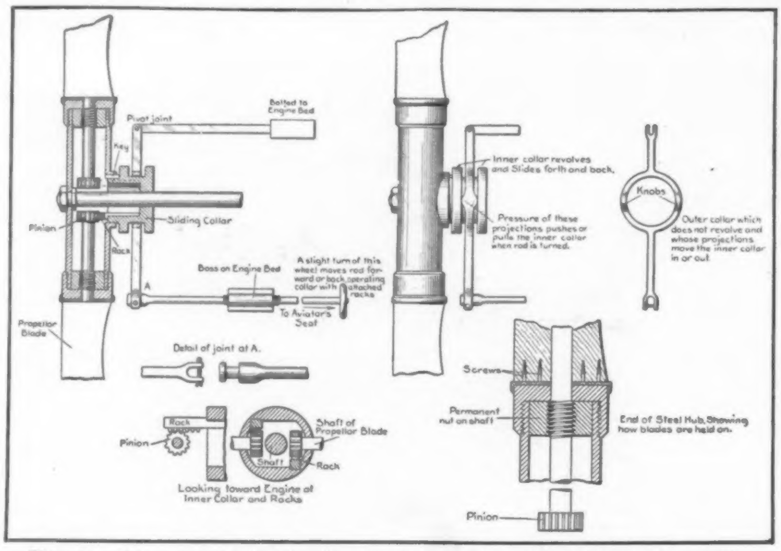
The new propeller is the invention of Robert I. Eustis and Seth Hart, both of Long Beach. The varying air conditions can efficiently be met by this device, thus overcoming one of the admittedly greatest menaces to aviation. The inventors point to the fact that on the steel hub of their propeller is a self-locking device which cannot be affected in any manner, save by the control of the aviator. Neither vibration nor air pressure has any effect upon the pitch, after the pilot has shifted to low, intermediate or high; and this change in pitch is so delicate that it may be changed to a micrometer adjustment. The fact that the steel hub acts as a fly-wheel and eliminates all vibration, was one thing brought out in the tests. It is claimed that the propeller causes the engine to operate more smoothly than is the case with the usual all-wood propeller.

While details concerning the adjustable pitch propeller just described, are not available, a method whereby a propeller may be made adjustable has been worked out by Joseph H. Roberts of Long Beach, Cal., and is presented in the accompanying line drawings. This method accomplishes all that the recently-tested propeller does.

It will be noted that as the aviator sits in his compartment, he has merely to turn a conveniently-located little wheel to change the pitch of his propeller blades, and adjust his machine to the varying air conditions, or increase his speed. This wheel turns a rod which passes through a threaded boss upon the engine bed, and attaches to a steel collar which encircles the hub of the propeller. The other end of this collar is held firmly by means of a pivoted rod which is securely bolted to the engine bed on that side. This outer collar does not revolve, but by means of projections upon its upper and lower edges, applies an even pressure upon the flanges of a second or inner collar. This sliding inner collar revolves with the propeller, but is so arranged that it can slide in or out, according to the push or pull of the outer collar. The sliding inner collar, in turn, operates the internal mechanism of the steel hub, moving the blades of the propeller.

By referring to Fig. 1 it will be noted that the internal collar has two racks projecting from the segmental portions at top and bottom. From the propeller blades, shafts extend through the steel hub, almost to the engine shaft, and upon the ends of these shafts are pinions. The racks, working backwards and forwards over the pinions, as the aviator turns the control handle upon the long rod, move the blades, thus changing the pitch, as indicated in Fig. 2. Centrifugal force locks the blades in their position, and it is impossible for the propeller to generate forward or backward thrust sufficient to force the rod through the threaded boss upon the engine bed; consequently the pitch cannot be changed other than by the aviator.

At the will of the aviator the pitch of these propeller blades may be changed while in flight



Figs. 1 and 2, respectively, showing the details of an adjustable pitch propeller

A Loom That Weaves a Fabric with Diagonal Reinforcement

THERE is probably no service which subjects a cotton fabric to so severe a test as that it has to endure in an automobile tire. The fabric serves as a reinforcement for the rubber. It is designed to withstand an enormous tensile strength in all directions, imposed by the steady pressure of air within the tire and must also withstand the sudden shocks due to the passage of the wheel over obstructions. At the same time, it must be perfectly flexible; for it is flexed constantly as the wheel runs over the ground. The fabric cannot have its strength increased merely by using heavier threads, for this would interfere with its flexibility.

It has occurred to an inventor, Mr. William G. Trautvetter of Paterson, N. J., that a fabric might be designed in which, in addition to the regular warp and filling, diagonal reinforcing threads might be incorporated. And starting out with this idea, he has designed a machine which will actually weave such a fabric. Anyone accustomed to handling looms or familiar with the operation of these machines, will realize how revolutionary must be a mechanism which will put bias threads into a woven fabric.

The machine which Mr. Trautvetter invented is pictured herewith, and although it may appear somewhat complicated, it will not be very difficult to understand its operation when we refer to the accompanying diagrams.

In Fig. 1, is shown an enlarged perspective view of the fabric with the threads spaced widely apart so as to show clearly the direction in which they run. The warp is shown at *A*, the filling at *B*, while the bias threads are indicated at *C*. It will be observed that the filling or weft threads always pass under the warp threads and over the bias threads.

Referring to the photograph, it will be seen that the bias threads are carried in spools mounted in a large revolvable reel and they run to a pair of screw threaded rollers, which are indicated at *D* in the Figs. 2 and 3. The warp threads pass through a needle frame *E* which periodically raises them through and above the bias threads, when the shuttle is thrown between the warp and the diagonal threads.

It will be evident that as the reel which carries the diagonal threads is revolved, the upper half of it will move the threads diagonally across the fabric in one direction and the lower half will move the fabric across in the other direction. The screw threaded rollers *D* serve to keep these threads properly spaced apart and moving regularly across the fabric. In operation the fingers of the needle frame pass between the diagonal threads and carry the warp threads upward, as shown in Fig. 2. Then the shuttle is thrown carrying the weft thread *B* across the fabric; the needle frame drops and the lay *F* beats the weft into place (See Fig. 3). While the needle bar is lowered below the diagonal threads, the latter are carried by their rollers in opposite directions so that when the needle bar rises again its fingers pass between another set of diagonal reinforcing threads. Thus, there is an interlacing of the diagonal threads with respect to the warp threads as well as an intermeshing of the weft threads with the warp and diagonal threads.

Such, in brief, is the operation of this machine, and the result is a fabric that is remarkably strong in all directions—one that is capable of withstanding a bias strain equally as well as a strain parallel to or across the run of the fabric.

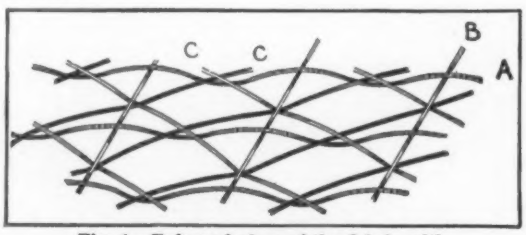


Fig. 1—Enlarged view of the fabric with bias threads

Treatment of Swamp Fever

DR. BARBARY, of Nice, appears to have found a very valuable remedy for swamp fever, this being an introveinous injection of 0.5 grams basic sulphydrate of quinine and 1.0 gram urethane in 125 c.c. physiological serum. This injection is easy to apply, and he claims that it is very efficient as a preventive, as well as good for impoverished blood.

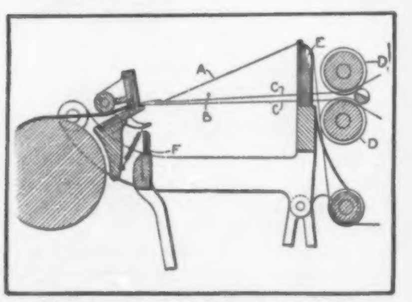
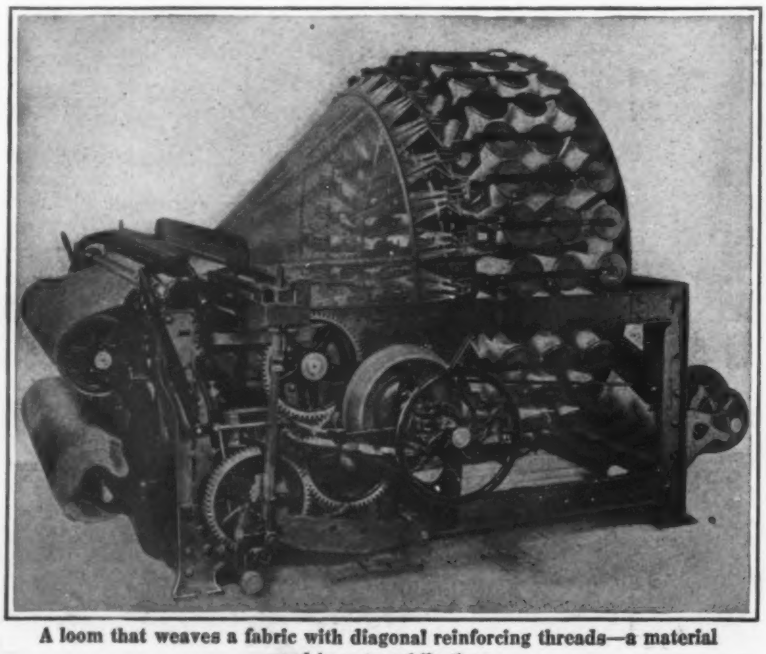


Fig. 2—The warp raised above the bias threads



A loom that weaves a fabric with diagonal reinforcing threads—a material used in automobile tires

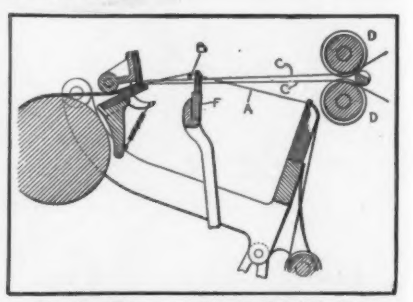
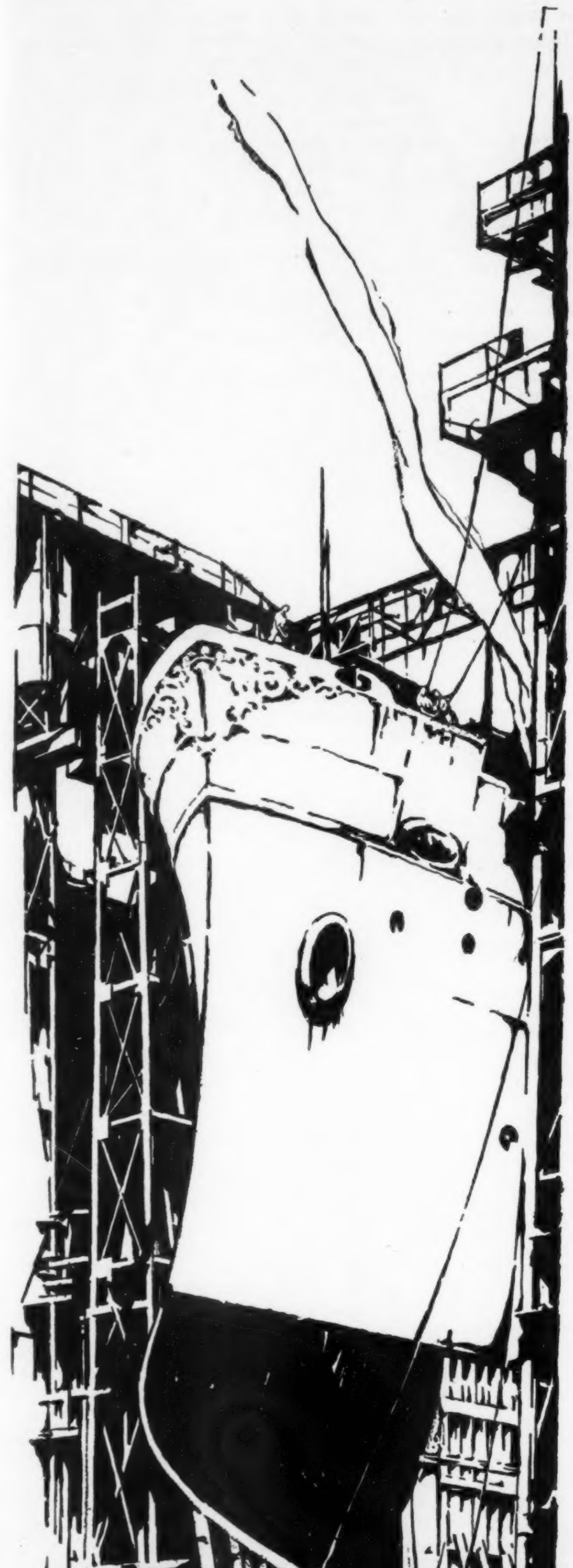
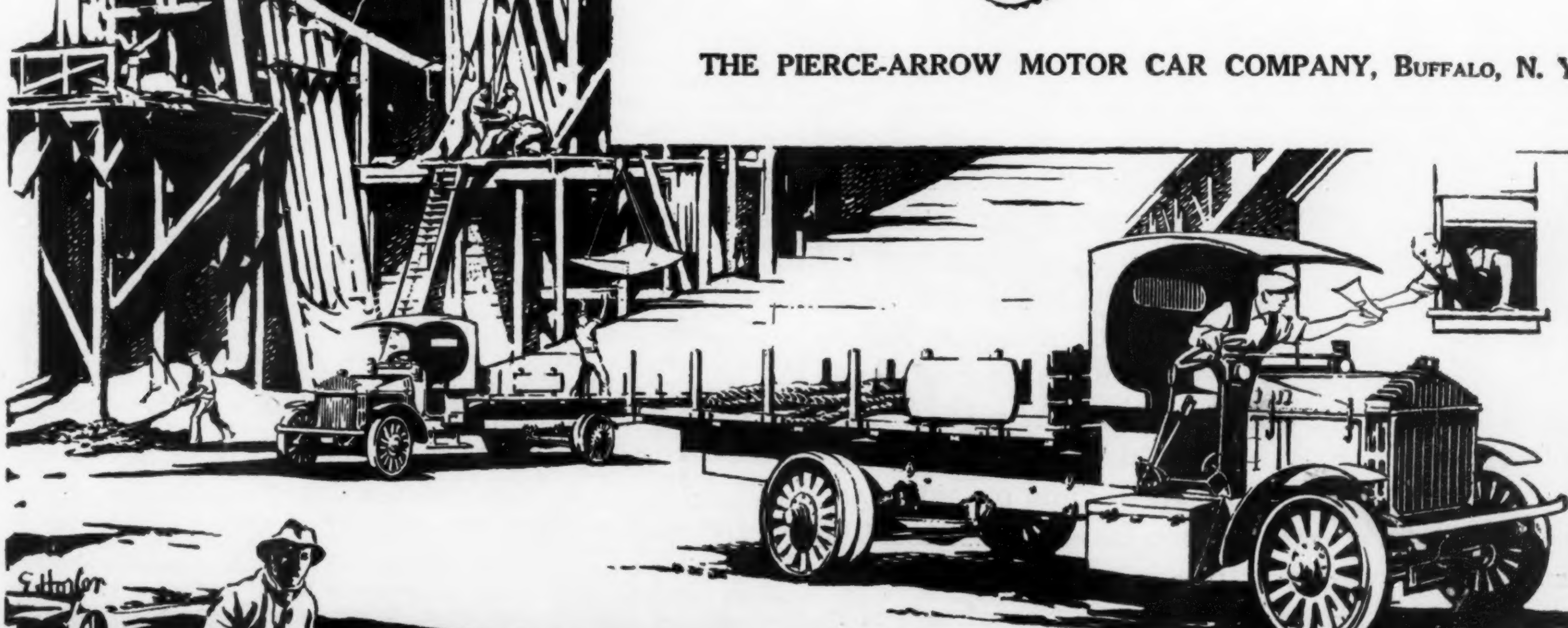


Fig. 3—The warp lowered while the lay is operating





German Raiders Which Put Out to Sea Without Crews

(*Concluded from page 377*)

convoys the raider is at all times within visual distance. Since power to drive the craft is entirely self-contained and need not be transmitted through the cable, the Germans have been able to use a much smaller cable and thus overcome the difficulties in this direction. It is evident that they use a one-wire cable, depending on the salt water for the return current to complete the circuit. The mechanism aboard the boat probably includes a contact making device operating by steps, so that certain combinations of impulses sent over the single-wire cable bring any desired set of contacts into position to perform the required operation.

Just how effective the crewless raider is in practice still remains to be proved. Perhaps the Germans, over-confident of their scheme, have been rather premature in launching their latest naval surprise. Perhaps the crewless raiders are best adapted to work at night or during foggy weather, when the craft, by means of hooded lamps as in the case of the old Sims-Edison torpedo, can remain invisible to the enemy while its course is in plain view of the seaplane observer.

But why have the Germans revived this idea? The answer is not difficult to find. For months past British monitors of shallow draft have been operating off the coast of Flanders, harassing with their heavy guns the German troops and organizations on the Belgian shore and hinterland. At times the Germans have had their communications seriously threatened by the shelling from the British monitors, and at all times they have been seriously troubled by these barge-like ships mounting huge 16-inch guns.

How to do away with the British monitors has been a sore problem with the Germans. Their shore batteries have been unable to inflict serious damage on the enemy because of their being outranged. Submarines could not be used against the British monitors because the waters off the coast are too shallow. Only a major naval attack could solve the problem—and then only if the German fleet were fortunate enough to escape the main British fleet.

By a gradual process of considering and eliminating every means of dealing with the troublesome British patrols, the Germans finally hit upon the crewless raider idea, which they have now tried, but so far without success. Surprise was the biggest factor in favor of the revived weapon; and though this factor is now gone, it will be interesting to note what success, if any, the Germans have in the future.

The Camera at the Front

(*Concluded from page 380*)

As a preliminary to a big offensive, tens of thousands of photographs are made of the enemy's positions and the country in back of him. These photographs are developed and printed, in some cases enlarged, and "read" by experts in back of the lines. The information gathered from these photographs is invaluable to the commanders, as can well be imagined; for it permits them to have their maps exceedingly accurate and up-to-the-minute. Thus, when the enemy lays down new railways, prepares new communication trenches, brings up new batteries, or constructs new concrete blockhouses or "pill boxes," the photographs reveal their presence, and they are accordingly marked in on the staff maps. In order to conceal facts from the prying eyes of the aerial cameras, camouflage is often executed in colors which photograph most poorly.

When the tremendous drum fire opens up on the enemy lines, the artillerists are guided largely by elaborate maps prepared from photographic data. In fact, much of the range finding is done by means of these maps, and the fire checked by aerial observers. And as the drum fire thunders on day after day the airmen aloft make more photographs, which, after being developed and printed, indicate to the "readers" at headquarters the extent of the artillery destruction, and in this way the commanders know when the enemys' works have been sufficiently pulverized or otherwise disorganized to render an infantry attack comparatively safe.

Of course, the enemy attempts to make photographs of what is going on behind our lines; for he is just as much aware as we are of the value of photographs in compiling his maps. But just as he attempts to block our camera-planes with his anti-aircraft batteries and battleplanes, so we block his. Cameraplanes, carrying heavy photographic apparatus, are naturally poor fighting machines; furthermore, the crew, intent upon getting the desired views, has no time to devote to fighting off hostile craft. Therefore each cameraplane is accompanied by swift battleplanes which hover about and are ever ready to drive off enemy battleplanes which attack the cameraplane. Much of the aerial fighting which takes place over the Western front has for its stake the acquisition, on the one hand, and the prevention or destruction on the other, of a number of photographic negatives.

Each of the big powers in the war has numerous types of aerial cameras now in use. At one time, when aerial warfare was still in its infancy, the French, British and Germans made use of small cameras of the hand type which were pointed over the side of the aeroplane in order to make a photograph. The Germans developed, for this purpose, an ingenious camera in the form of a long and slightly tapered body, equipped with a direct-view finder and a pistol grip. The shutter was released by pulling a trigger, and the entire apparatus was strongly suggestive of a revolver. This camera, like most of the others, was equipped with a focal plane shutter. But the demand for clearer, sharper photographs has given rise to big, long-focus cameras.

While details regarding the various cameras now in use are naturally most carefully guarded by the various nations at war, it is known that the present tendency is toward still larger cameras, which, in many instances, are built into the planes. The French are making use of a camera which measures over four feet in length, with a slightly tapered body ending in a lens board. The airmen refer to it as the "vest-pocket" camera. Obviously, such a camera could not be lifted over the side of the aeroplane nacelle because of the surface which it would expose to the onrushing air, and hence it is installed in the aeroplane body with the lens pointing down through a hole or well, while the machine is maneuvered into position for making the exposure. An improved type of Italian camera automatically makes photographs at predetermined intervals on a strip of film, and as each exposure includes in one corner the image of a compass, the individual prints can be more readily assembled by the "readers" and compilers at headquarters, since the points of the compass are given with each one. Here in America there has been developed an ingenious camera which makes use of standard motion-picture film, and which, by means of a cable release, can be operated by the airman at any moment. From 1 to 750 exposures can be made on one roll of film, and because of the small bulk and the light weight of this equipment, it is quite possible for two or more cameras to be carried by one aeroplane, if desired.

In planning and executing air raids the camera is of great value. In some instances previously-made photographs are used to guide the raiders in their contemplated work of destruction. On such prints the most important objectives are marked in with ink and properly lettered to correspond with the instructions issued to the raiders. During the raid photographs are sometimes made in order to ascertain the extent of the damage.

Aside from aerial photography, many other uses are found for the camera in the present war. Motion picture films and hundreds of thousands of still photographs have been made of every phase of the fighting, from the destruction of entire villages to the hand-to-hand fighting in No Man's Land. While these films and photographs serve to keep those back home informed as to what is taking place at the front.

The Scout Movement and the Engineer

(Concluded from page 381)

New York. One of the most popular activities of the winter was a course in gallery rifle practice given by one of the officers of the Post, as a result of which seven boys qualified for the War Department's badge of proficiency. During the year the troop exchanged visits with Mr. M. B. Sackett's troop of River Edge, N. J., and each visit was made the occasion for an inter-troop competition. In the summer the second camp, "Camp on-the-Map," was held at the old camp site. During the spring the scouts had made two seaworthy skiffs, which added to their enjoyment of this camp. The champion swimmer of the Corps of Cadets came to camp to give a lesson in the crawl stroke, and the Post Forester and a Signal Corps sergeant also gave their services as instructors.

The story of the third year can be briefly told. Many "merit badges" had now been earned by the scouts in such subjects as cycling, markmanship, civics, leather craftsmanship, scholarship, first-aid, horsemanship and interpreting. The examinations were given by professors and officers on duty at the Academy, and by other authorities, and ensured that the scout had made substantial efforts and progress in each subject. The annual show that winter, consisting of a three-act play, selections by a scout orchestra, and stunts, was largely attended and applauded by the entire Post. In the spring the troop was invited to come to New York to give an exhibition at the Scout Officials' Educational Conference, which included the construction of a miniature bridge. In the spring, after war was declared, the troop responded to the nation-wide impulse, and ploughed and planted a new tract of land, with a success that is now bearing good fruit. Later on, when the Boy Scouts were asked by the President to assist in the sale of Liberty Bonds, the West Point Troop turned in nearly $10,000 worth of subscriptions.

Just before the date arrived for the third annual camp, I was relieved from duty at West Point. But the camp was held, and the troop will continue its activities.

The above is the tale that hundreds of scoutmasters can tell, who have watched their boys develop in fitness and self-confidence and manliness, and have found their troops appealing more and more to their own interest and devotion. It takes a good deal of time and effort—let no one deceive himself—to be a successful scoutmaster. Yet much of this time a man would give to recreation, and in scouting a scoutmaster can recreate himself. And few things that a man can give his time to will yield such large dividends, such satisfaction as comes from this contribution to better citizenship.

Now a word as to the particular value of scouting to the Nation *now*. I took my troop because the boys wanted me, with no thought of possible military significance in the movement. It is true, also, that the scout movement is "non-military," as it should be. Soldiering is a man's job, and the young boy needs an untrammelled boyhood, stimulated by the many-sided activities of scouting. For all that, I maintain that our scout organization is a military asset of great value. First of all, our scouts have learned to take care of themselves in the open, to march long distances, to become, in short, *physically fit*, and that is a very fundamental and important military consideration. Again, their scout training has included many subjects directly useful in a military sense such as signalling, first aid, mapping; and has, in general, greatly increased their alertness and initiative. Officers have found that soldiers previously trained as scouts knew better how to take advantage of cover, and were superior in a dozen ways, as a result of their scout training and games. Moreover, the scouts, when properly handled, have learned obedience and self-control; their "gang spirit" has been directed into disciplined team-work, and through the daily good turn and the helpful attitude towards the other fellow, they know how to render a patriotic devotion to a cause outside of and bigger than themselves.

An incidental, but by no means unimportant consideration arises from the training of the scoutmasters themselves. I have no figures available, but I have no doubt that the 11,565 registered scoutmasters, the 13,202 assistant scoutmasters and the 47,462 other officials have furnished a fertile field for officer material for our National Army. The problems that arise in organizing, training, and disciplining a group of scouts are not so very different from those with a command of slightly older enlisted men. I am convinced that my own efficiency for troop work was increased by this contact with the boys, which was in entire contrast with my professional duties at that time.

Enough has been said to suggest the wide field of opportunity for useful service which scouting offers. To take advantage of these opportunities, the need for men is urgent. Many scoutmasters have left their troops for service at the front. Their places must be filled, and leaders secured for the many new troops which are waiting to be formed.

For this task of leadership the engineer is peculiarly fitted. His out-of-door life, his knowledge of the forces of Nature, his contact with men—all equip him (assuming in addition a fondness for boys) to be an ideal scoutmaster. Scoutcraft will have no mysteries for him, but it should prove a fascinating study, providing full scope for his engineering ingenuity. For it is education of the highest quality that he is contributing to. Dean Russell of the Teachers College of Columbia, has paid this remarkable tribute to General Baden-Powell, the founder of the scout movement in England, that he considers the latter has done more to vitalize education than the schoolmen of America in a century. Such is the opportunity. Surely the engineer, who has already contributed so much, has only to realize this fresh need before responding to the call for Service.

Some Super-Zeppelin Secrets

(Continued from page 386)

The super-Zeppelin is commanded from an enclosed bridge, just forward of the wireless room. In order to protect the occupants from the cold and wind, the bridge is provided with a three-ply windshield and a heavy fiber mat. All the controls are at hand, so that the giant airship, like its counterpart on the high seas, can be guided from the bridge. For operating the vertical rudder and the elevating planes, handwheels are provided, much after the fashion of those used on motor boats. An elaborate chart table also forms part of the bridge equipment, as does a control board containing 38 red and white buttons, each of which takes care of the expansion or the contraction of the balloons. Light-weight stools made of three-ply thin wood are used in the navigating room by the crew.

The power plant of the L-49 consists of five separate units, the largest of which is just aft of the wireless room. Running the full length of the envelope is a narrow gangway which permits the crew to walk from one part of the aerial greyhound to another, giving ready access to any one of the engine rooms. At one point there is a well or tube, formed of balloon fabric, enclosing a light aluminum ladder which leads to a small gun platform mounts top of the envelope. This platform mounts two machine guns which can be brought to bear on hostile battleplanes attacking the airship from above.

The other power units are contained in bullet-like gondolas or cars which are suspended below the balloon proper. and which are reached from the gangway by climbing down eight-foot ladders. Each of these gondolas contains two engines which drive a single propeller, and the arrangement is such that either engine can be employed separately to economize fuel when full speed is not required.

The envelope of the Zeppelin contains 19 balloons of gold-beater's skin, with

(Concluded on page 394)

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Some Super-Zeppelin Secrets

(Concluded from page 392)

ballonets inserted in each one, so as to form an integral member. These ballonets are an essential part of each balloon unit, and serve to take care of the expansion and the contraction of the hydrogen gas, thus maintaining the proper conditions in each balloon regardless of the altitude at which the airship is traveling, the temperature, or any other vital factor. The ballonet valves are under the control of the navigator on the bridge, through the agency of the 38 little white and red push buttons on the control board before him.

Also contained in the envelope are the water ballast tanks, so arranged as to distribute the weight along the entire length of the craft. These tanks are of canvas, and each has a capacity of about 200 quarts. Any desired tank can be drained of its contents from the bridge, and the buoyancy of the Zeppelin can be delicately and readily controlled.

Fuel for the engines is carried in 16 tanks of substantial construction, so piped that any one of the tanks can be used to feed one engine or all the engines. The German constructors have evidently taken every precaution to safeguard their fuel storage and distributing system in order to reduce to a minimum the fire hazard.

Of the other equipment of the L-49 little can be said at the present writing, due to the complete absence of details. It is known that a parachute was found in one of the engine rooms, suggesting that parachutes are perhaps used by the crew to escape from a doomed Zeppelin. Hammocks were found in considerable number, indicating that the crew rest after the fashion of sailors on board warships. But the chances are that the better part of the instruments and miscellaneous equipment was thrown overboard to lighten the craft when the crew was bending every effort to escape a French battleplane, just before landing.

All in all, the L-49 is an interesting craft. Still, after the many wild rumors which continually emanate from Swiss sources concerning the wonderful super-Zeppelins being tried out over Lake Constance, the secrets betrayed by the present type are somewhat disappointing. There is no evidence of marvelous bomb-dropping apparatus, tremendous speed, all-powerful armament, gigantic proportions, mist-producing machinery for hiding from enemies, or non-inflammable gas in place of hydrogen. Again we are led to believe that these things exist mainly in the minds of the Teuton *camoufleurs*, whose chief rôle is to inspire fear among the civilian population of enemy countries.

The Yellow Jacket vs. The Skunk

THERE is in nature a certain balance, an equilibrium carefully maintained. Man as a renegade, an interloper, disturbs this relation from time to time and in various ways. We cannot disturb or destroy any animal or change its environment without interfering with many others. For instance, when Dame Fashion calls for skunk fur this animal has been trapped in all parts of the country and its numbers greatly reduced. Curious results have come from this most notably in the insect world.

The staple food of skunks in summer is insects and the number of insects a single skunk devours is enormous. As the amount of harm these insects do runs into appalling figures the value of the skunk to the agriculturist and fruit grower is evident. Unlike the birds its value is not offset by a destruction of grain. In the spring insects are scarce and birds eat grain and seed. The great economic importance of the skunk has been illustrated during the past summer in the plague of yellow jackets. Skunks ordinarily dig up the nests that these sharp stinging hymenoptera build in the ground and eat the insects and larvae. The increase in yellow jackets is no doubt due to the extensive trapping of skunks and so troublesome have they become that fruit growers are considering asking for a law to protect the skunk.

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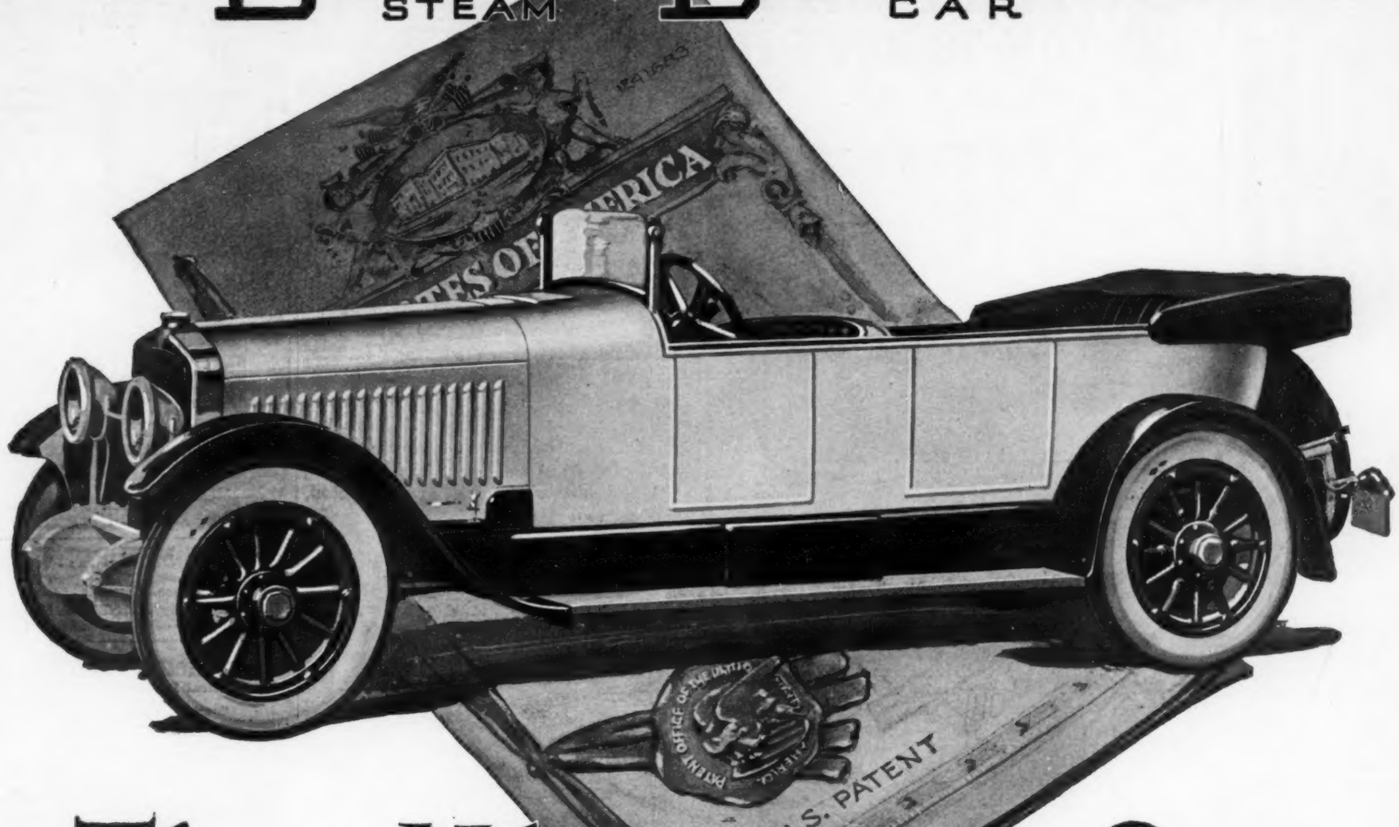

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Doble-Detroit Steam Motors Co., Detroit, Michigan

Fatigue Toxins

By May Tevis

NOW that many of our troops will soon be undergoing intensive training in Southern quarters, it behooves those responsible for their physical welfare to profit by the numerous studies which have been made by European surgeons during the past three years. One of the recent investigations applies with peculiar force to raw troops. At a session of the French Academy of Sciences held in Paris on May 14th, Dr. Jules Amar presented the results of his exhaustive study of the nature and prophylaxis of sunstroke.

Dr. Amar declares uncompromisingly that this affection is essentially toxic in origin. Its determining cause is the presence of the toxins due to muscular fatigue, plus insufficient oxygenation of the blood. Prevention rests chiefly in the avoidance of prolonged and intensive labor; in the use of loose, light clothing, especially as regards the chest and neck; and in having hard muscular work times and inspected, with suitable intervals of rest.

Dr. Amar's methods of gaining this valuable information and the incidental details of his experiments are of much interest. The subjects of experiment were robust laboring men, from 20 to 40 years of age, non-alcoholic of habit. They included farmers, ditch-diggers, soldiers, sailors, etc. Many experiments were made at temperatures, *in the shade*, of 35° to 39° C., *i. e.*, 95° to 102.2° F. The experimenter found that, whether in sun or in shade, prolonged hard labor led, towards the end of the fifth or sixth hour, to functional troubles and the symptoms indicative of sunstroke, namely, headache, giddiness, sleepiness and paleness of face. On the other hand, where the work was timed and interrupted by frequent intervals of rest, and where the muscular strain was not too severe, these distrubances did not occur, even at high temperatures.

It was particularly noted, likewise, that, even with the same degree of fatigue, there was a much greater degree of resistance to heat when the individual was able to breathe freely and deeply. Obviously such ease of respiration is interfered with by garments too tight about chest or neck, and here we have a physiological reason for the use of "sailor collars" and "sport-shirts," and a physiological condemnation of the stiff collar and tight cravat.

Dr. Amar remarks emphatically: *heat-stroke does not occur except as a result of fatigue, and is extremely rare when the pulminary ventilation is excellent.* These conclusions had, in part, been arrived at some years ago by doctors Laveran and Regnard. But it was also proved by experiment that respiration is greatly interfered with by sudden and violent muscular efforts; lung ventilation under such circumstances is 25 to 30 per cent less than in rhythmic and periodic labor, even when the latter requires equal effort.

Intense heat also affects the breathing, causing a characteristic laboring, with short inspiration which insufficiently aerate the lungs. Moreover, heated air is so dilated as to diminish its percentage of oxygen, for this gas has a coefficient of expansion materially larger than that of nitrogen.

In accordance with this theory Dr. Amar found that it was immensely useful to men engaged in hard labor to make them pause at stated intervals, chosen with reference to the requirements of the work, and take several deep breaths. In deep breathing no less than three times as much air enters the lungs as in ordinary breathing, and there is a corresponding supply of oxygen available. When taking these deep breathes each of which should give the lungs about three liters of air, it is advisable to take them with the head bent backward and the mouth open. These observations make it clear that yawning is an instructive effort of nature to relieve fatigue toxins by increased aeration of the blood. A final recommendation to those in danger of heat-stroke is to snuff up a mixture of vinegar and water and also wet the face with it, since this liquid induces a sensation of coolness which stimulates the respiratory reflexes.

LIBERTY WAR NUMBER

4

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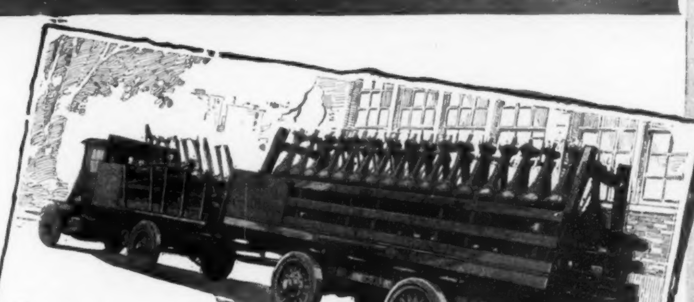

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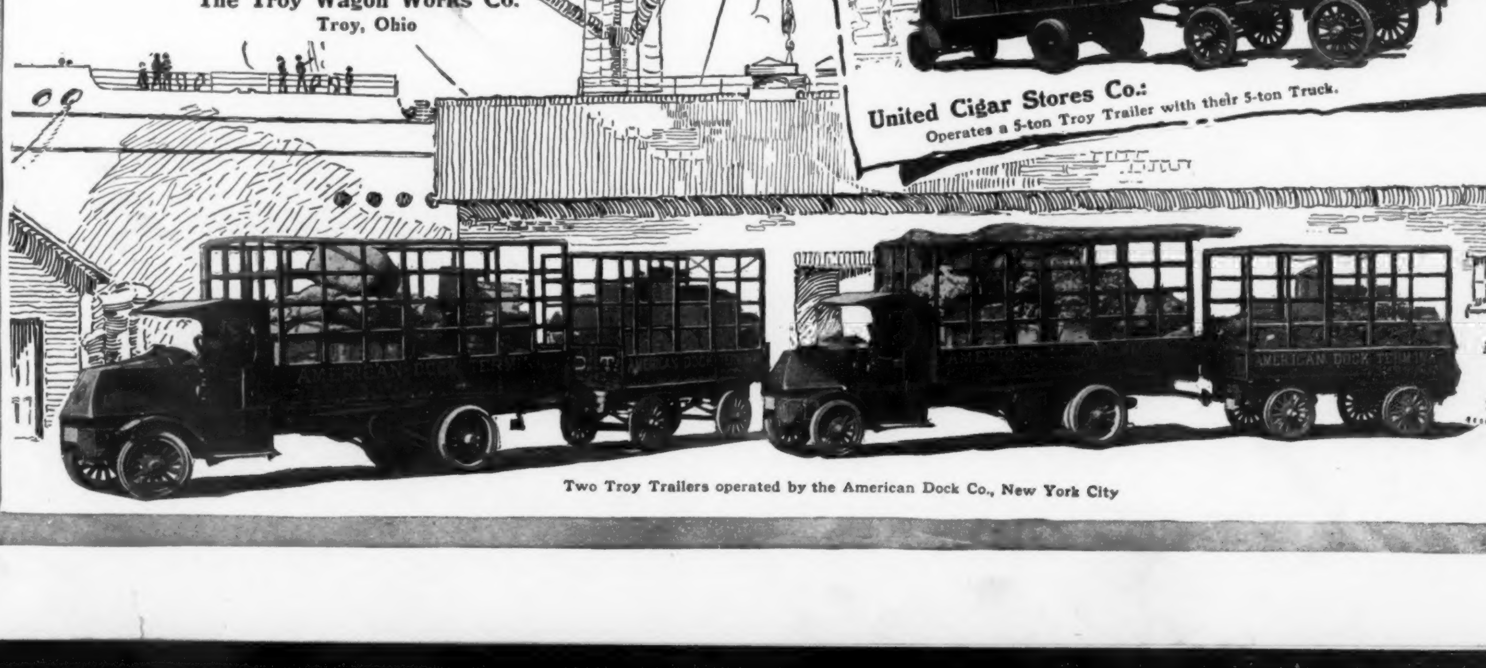

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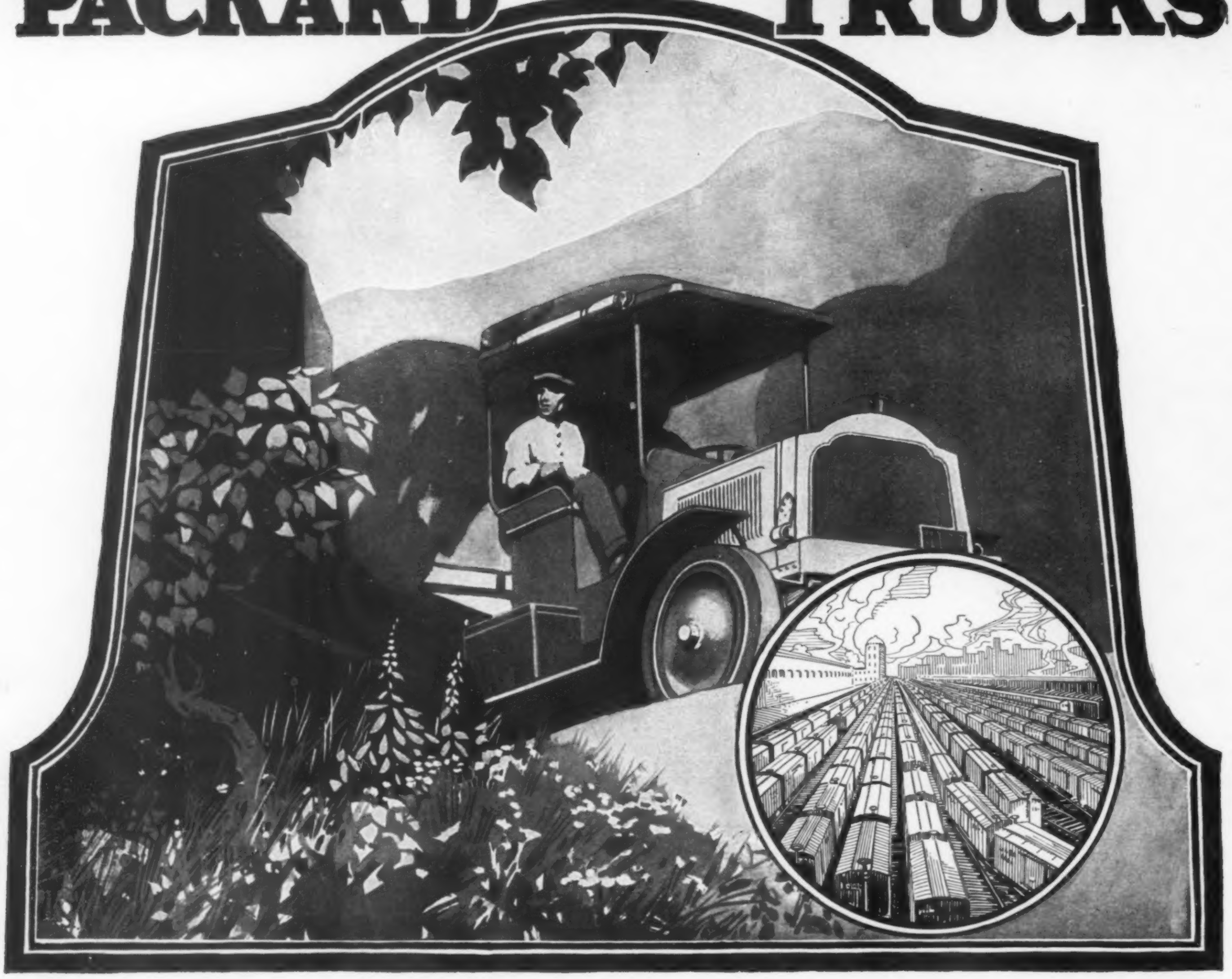

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